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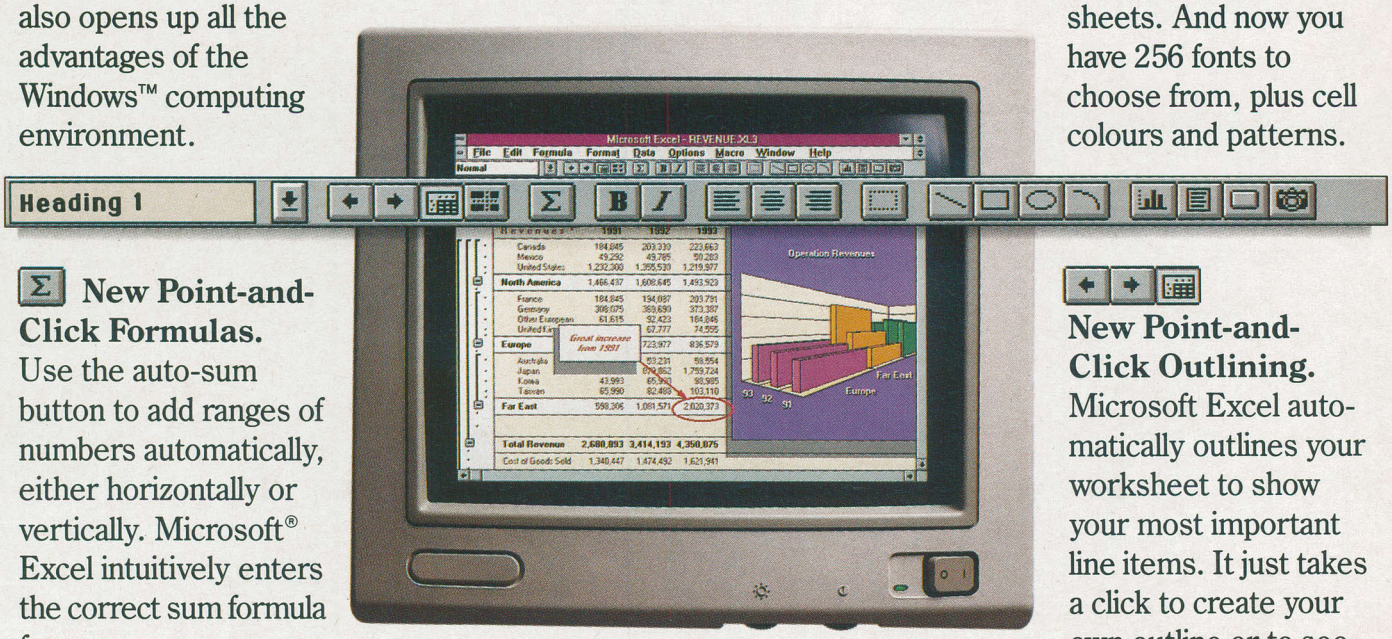

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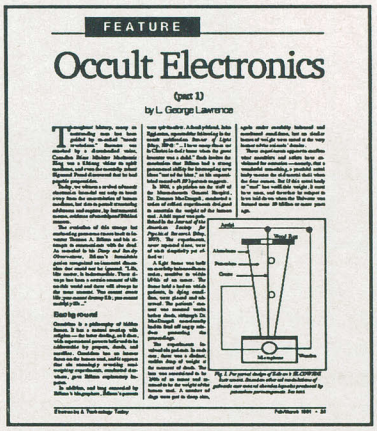
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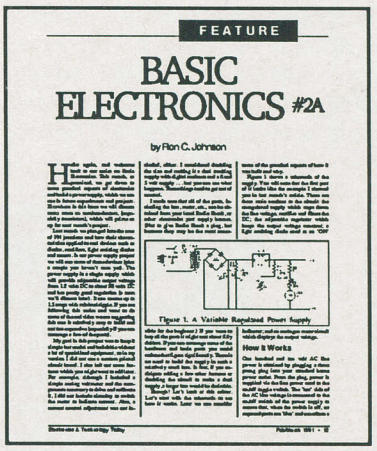
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The photo on the front cover is a computer graphic from the Information Technology Research Centre at the University of Toronto.
Thanks to Ron Riesenback for the use of this material.

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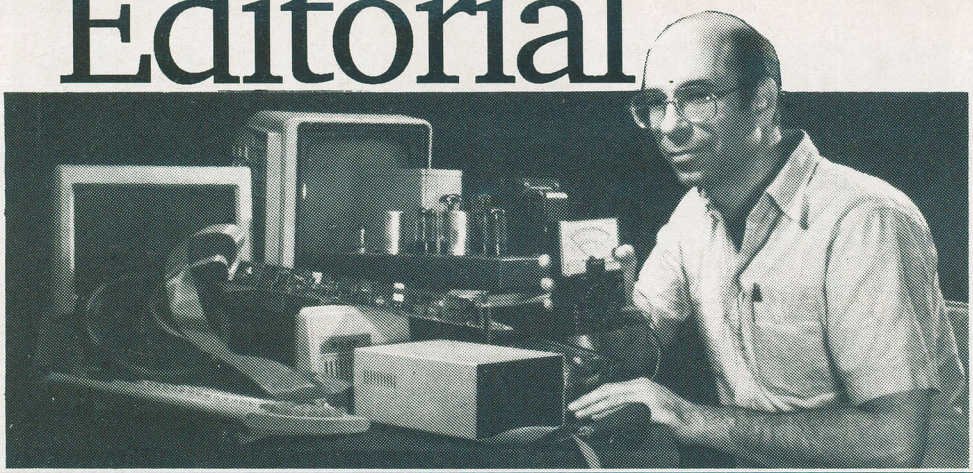

Hello to all our readers. This issue marks the thirteenth year of the publication of *Electronics and Technology Today*. As a matter of fact, I remember anxiously waiting for and buying the first issue. Believe it or not, I still have it! In my wildest dreams, I never thought I would be the editor of this publication.

The theme of this issue is "Canada's Role in High-Technology." There are several examples contained within, some of which include an article about research at the University of Toronto, and a feature about Canada's research databases. I had much more material on this subject, but due to space considerations, I could not include everything. However, I think we can all be proud of our many achievements.

In an effort to bring to our readers more quality projects, I'd like to take this opportunity to announce the **Great Canadian Project Contest.** This contest is open to everyone. All you need to do is send in (to the address below) your best projects including schematic diagrams, pc board patterns (if applicable) and of course, pictures (black & white glossy preferred). In an effort to tap and encourage the creativity of our youthful citizens, I intend to go into the electronic schools and personally talk with as many students as possible, encouraging them to participate. All suitable projects will be published in *Electronics and Technology Today*. Payment will also be included for those projects chosen.

So get out your breadboards and spare parts, and let's see what you can do!

Chuck Ander

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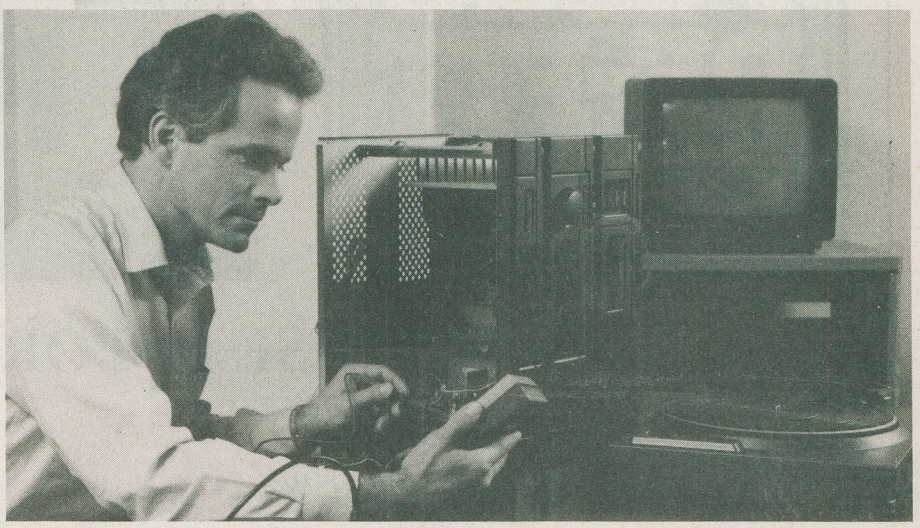

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MARKHAM, ONTARIO — (December 10, 1990) — Paco Electronics Ltd. is proud to introduce Fuji's newly developed DOUBLE COATING technology. Offering significant improvements in audio and video performance,

the new line-up of Fuji videotapes's now available.

DOUBLE COATING technology was developed to increase picture resolution and improve video sound quality. It is an advanced extension of the sophisticated coating technology used in the manufacture of Fujicolor film.

To mark the debut of this line-up, Fuji's DOUBLE COATING videotape products will appear in vibrant new packaging. The new package design was developed based on consumer surveys in Europe and North America — the final design reflects a technically advanced image appropriate for this selection of high-performance videotapes. This line- up heralds a new era of quality video viewing.

Fuji's DOUBLE COATING videotape line-up consists of:

High-frequency components (such as video signals) are recorded near the surface of the videotape's magnetic layer while low-frequencies (like linear audio) are recorded deep into the layer. Conventional videotapes have only a single magnetic layer for all these frequencies. A tape using relatively large-grain magnetic particles would handle low- frequency signals well, but respond poorly to mid- and high frequencies. Conversely, extremely fine particles provide good high-frequency performance, but prevent optimum output of mid- and low frequencies. This makes it extremely difficult to improve simultaneously all the response characteristics of a conventional single-layer videotape.

Fuji's DOUBLE COATING technology makes use of two magnetic layers. The upper layer employs newly developed ultrafine-grain magnetic particles optimized for mid- and high-frequency response, while the lower layer uses new fine-grain particles for superior low-frequency characteristics. Together, they provide unprecedented performance across the entire frequency range. ❐

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Sperry: Inventing the 20th Century

by George Colpitts

The last years of the 19th century began the golden age of the electronics hobbyist. Henry, Foucault and Ohm might have previously fine-tuned principles of electricity and physics, but it was backyard tinkerers such as Edison, Weston and Siemens who hammered such principles into every-day life. Often at odds with academic scientists, wild-haired inventors and armchair science buffs experimented with the internal combustible engine for cars, dangled from unstable dirigibles or killed themselves in elaborate airplanes. Store catalogues and patent monthlies were crowded with contraptions reflecting the come-hell-or-high-water determination of their creators. "Invention is 95 per cent perspiration," Edison had said, probably without exaggeration and most innovation amassed man-hours which would make modern R&D groups cringe. But the years were exciting. These hobbyists eventually created, patented and sold modern convenience, the degree of which we have never been able to fully match.

Any look at early innovators would have to include inventor-*extraordinnaire*, Elmer Ambrose Sperry, whose hands produced gadgetry which changed the planet. He was lionized as an engineer, initiator of dozens of corporations, including the Sperry-Rand corporation, and the dreamer behind modern avionics, gyro-compasses and truly closed-looped systems.

With little education apart from the reading of 19th Century *Scientific American* magazines and patent journals, Sperry began his career as inventor in home-State New York. As a boy he had set his veranda on fire experimenting with benzine vapours, injured a playmate with a homemade glass-blowing outfit and was generally known as "that Sperry boy." But by the time he was a farmhand adolescent, his mechanical aptitude and avid reading joined together in a mind that innovated, it seems, without coaxing.

Elmer Ambrose Sperry

At 19, Sperry perfected the closed-loop, or self-regulating arc lamp. A few years later he was perfecting mining machinery, developing street cars which impressed the world, and delving into electro-chemistry. In the 1890s, he patented a storage battery which drove an electrical car 87 miles (other batteries at the time charged for 30 miles at most). The Sperry gyroscope, the searchlight which lit up skies laden with World War One Zeppelins, the gyro-compass, the automatic ship stabilizer, and the automatic pilot for aircraft eventually became his children.

And children they were. Sperry's ideas were borne on paper with pencil; his ability to visualize and draw concepts, systems and electrical theory was so complete he was able until his death in 1930, to pass pages of diagrams and sketches to engineers sufficient to initiate yet another Sperry product. More than visualized, most of his 400 patented inventions gained personalities in the Sperry mind. He described them as "he" or "that brute" or "that fellow."

Although he grasped blueprint intricacies, Sperry was a slow reader, and

The Sperry streetcar at the Chicago World's Fair, 1893. Elmer Sperry, right, has his hand on the brake.

friends who had to read silent movie subtitles aloud to Sperry, were relieved when talkies were produced. A notorious speller, he wrote in a notebook, "Hydrochloric acid out of salt by electroleciss." He lived in fear of his teacher's warnings that a poor speller, "might be able to attain the dignity of a grocer's clerk ... but nothing more." "Now that I have lived it down," he said later, "I can see that the whole world does not revolve around spelling."

Sperry's world revolved around technology. Yes, he became a proficient speaker, polished public figure, and writer of passionate poetry to his wife, but Sperry was most comfortable in the intricacies of electricity and engineering. As biographer Thomas Hughes said, "Sperry expressed himself in technology."

Sperry's first chance to express himself came on New Year's Eve in Chicago, 1885, having laboured for weeks installing what he termed the greatest concentration of light in the world — bundled arc lamps — atop the 300-foot tower of the Chicago Board of Trade building. Waiting at the lighting switch was heart throb and future wife Zula Goodman.

On the whole, Chicago was dimly lit. Gas lighting flickered down its streets but only barely lighting sidewalks. Edison's high-resistance, carbon-filament incandescent bulb had been created previously but had limitations for lighting public places.

Over the previous two years, Sperry had been attacking the two major weaknesses in arc lighting. First, he had designed a generator that produced a constant current despite variations in the speed of the steam engine driving it. Second, Sperry had developed automatic regulation of that generator to supply constant current despite load variations — especially when arc lights were cut out of a circuit.

Sperry was really beginning present-day cybernetics, and even though closed-looped systems have always been attractive to electronic and mechanic buffs, few up to Sperry had been able to develop so complete self-regulating mechanisms.

Sperry's arc lamp carried "error signal" intelligence. Within the generator, an adjustable spring was set for the desired current and an electromagnet with a movable armature represented the actual current. The force of the electromagnet tended to move the armature in one direction and the tension of the spring, attached to the armature, in the other. Movement in "error" activated a servomechanism that rotated the brushes of the generator until the output matched the desired current.

When Zula turned the switch, saying playfully, "let there be light," the twenty lights suspended on a ring burst 40,000 candles of light as far as Michigan City, 60 miles distant. Chicago streetcar conductors and drivers reported that all viaducts in the city were well lit, and light reached city limits.

"The atmosphere was very luminous," said Chicago Tribune, "and as far away as Douglas Park houses cast shadows from the light...."

For Sperry, the closed-loop design for the arc lamp carried into most of his other inventions. By 1893, he was demonstrating a superior hill-climbing street car at the Chicago World's Fair with a developed power transmission, electric brake and related controller. The electric brake was interesting. Instead of using an electromagnet to pull the brake shoe against the braking surface of the wheel, he designed an annular electromagnet concentric with the

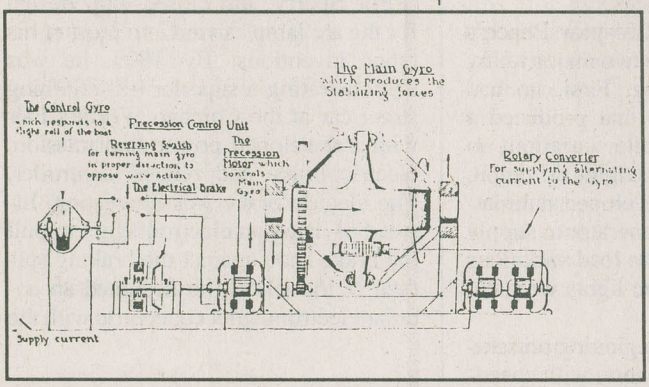
axle of the wheel, but attached to the frame of the vehicle.

Street car innovations naturally lent itself to the still-developing automobile design. Sperry's fingers were on almost every form of technology rapidly forming, the "horseless carriage" being no exception.

Automobiles were being developed in Europe and North America along two philosophies. The internal combustion design, broadly patented by George Baldwin Selden, hiccuped a lot of smoke and noise. The more expensive alternative, which Sperry's "six electrics" were built around, relied on electricity.

Sperry had unwavering faith in electricity. He had a gasoline vehicle at one time, "a thing of beauty with two cylinders, steered by a tiller, upholstered in English Wilton and trimmed with aluminum." But the car was destroyed in a workshop fire, and seeing the wreckage Sperry said to his sons, "that's what you get for deserting electricity."

The Sperry family, about 1910. Standing: (L. to Rt.) Lawrence, Elmer, Jr., Helen. Seated: Elmer Sperry, Edward, Zula.



From The Sperry Gyroscope Co., "The Sperry Ship Stabilizer"

Of course, Sperry approached his car design from different angles. He applied for auto patents for air-cooling the motor, a control system, power-transmission gearing, clutch and brakes. But primarily, he attempted to better the battery power. Sperry's battery contained diaphragms, or separators — fibre composition placed between the plates carrying the peroxide which kept the plates wet with acid. At the same time, the separations kept the plates from losing their peroxide, warping, or coming into contact with each other. The "Sperry Grid" eventually became popular batteries for streetcars, electrics, lights and power stations.

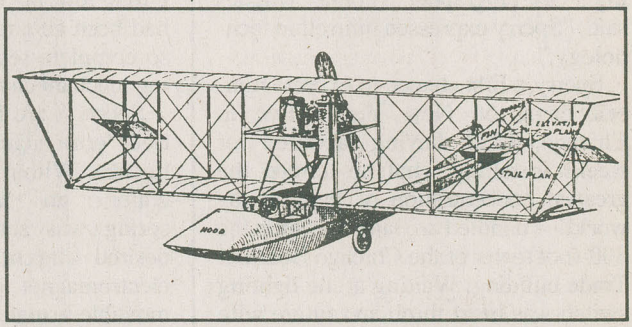
The other problem Sperry addressed was stability. Turn-of-the-century vehicles tended to flip easily. Sperry's own son, Elmer, Jr. narrowly escaped injury when he was thrown from a car and Sperry saw the most pressing concern was to stabilize the vehicle, and he turned, as he did throughout his life, to the gyroscope.

Sperry had approached Barnum and Bailey with his first gyro-invention: the "wonderful trained wheel-barrow," a wheelbarrow concealing a gyro that allowed tightrope walkers to hop in and around it without losing their balance. But Sperry had seen gyroscopes applicable to almost every major technology, his car included.

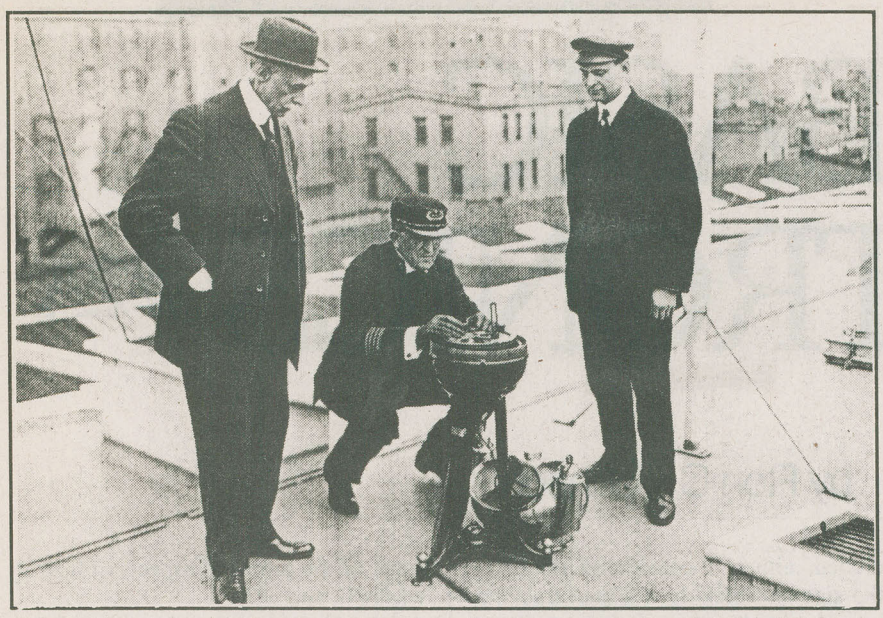
By mounting a precessing gyroscope in the bed of his car, Sperry calculated that a 200 pound wheel could develop more than four tons of resistance to a tilting force. Sperry's contribution to emerging automobile designs was limited. But precessing, or the capability of angular motion in a plane at right angles to the upsetting force, was central to almost all Sperry's application of the gyro. And these applications soon changed the nature of shipping and aviation.

Sperry's life-long fascination with the gyro was not unique to the Victorian mindset. The forces at work within a spinning gyroscope were as full of promise — and elusive to control — as 20th century theories of fusion energy. From the 1880s onwards, dozens of hackers had filed gyro application patents and few of them worked.

In the early 1900s Sperry brought home a gyroscope top for his sons to play with but confessed that he hogged most of its use. Through their growing up years, his sons were deluged with gyroscope toys and Sperry accumulated a library on the subject. By 1910 he envisioned a gyro with two or three degrees of freedom serving to stabilize rough-riding cars, rolling boats and out-



The Curtiss flying boat. The Sperry stabilizer of 1914 was installed on a similar aircraft.



Sperry examining the repeater compass for his gyrocompass installation aboard the Princess Anne, *1911.*

of-control airplanes, or guiding them as a compass by pointing to the axis of the earth. The eventual development of the Sperry gyro-compass, the "Metal Mike' (an automatic helmsman for large steamers) and stabilizers and autopilot mechanisms for aircraft eventually grew from his living room musings.

Sperry's gyro-compass was actually successfully test mounted on the U.S.S. Delaware in 1911, installed in a crude square frame "set up on pipe legs." Sperry's gyro technology soon became central to seafaring. Boats and submarines relied on the compass for direction, and they relied on Sperry stabilizers to lesson stomach-churning rolling on the high seas.

The most fascinating gyro application took place in aviation, however. Perhaps stabilization was a luxury in other areas, but in aviation, especially in the precarious Wright designs, stabilization, or lack thereof, was the greatest challenge after flight was finally attained.

The Wright design placed the onus on the pilot to control all factors affecting his craft. Once airborne, the pilot pushed petals and swung levers — almost frantically — to maintain stability. Not only did a flight require awesome coordination, but stamina.

Sperry's first experiments with aircraft stabilization, fixing a passive gyro to the bottom of Stanley Beach's airplane in 1907, failed. But in 1912, by then working with his son Lawrence, and teaming up with intrepid pilot Glenn Curtiss, Sperry developed an effective automatic stabilizer before World War I which transformed during the war into a major component of an automatically controlled missile. This would be converted into an automatic pilot after the war.

Lawrence must have been fascinated with his father's affiliation with speed-demon Curtiss, especially in light of the boy's love for aviation. In the summer 1910, when his family was away, Lawrence changed the Sperry home into an aircraft factory. He used attic, cellar and bedrooms as work rooms and fired the furnace (drained for the summer) to speed up the dope drying on the wing fabric. When the family returned, Lawrence displayed the airplane in the backyard. But inside, the family found the front hall bannisters had been torn out, that a wall had been demolished to roll the plane into the backyard and the furnace had cracked. Lawrence eventually became a capable pilot, but died when his plane crashed in a channel crossing to France in 1924.

By 1914, Sperry created the gyro design which still endures in missile

see **Sperry**, *page 17*

FEATURE

BASIC ELECTRONICS #2A

by Ron C. Johnson

Hello again, and welcome back to our series on Basic Electronics. This month, as promised, we get down to some practical aspects of electronics and build a power supply, which we can use in future experiments and projects. Elsewhere in this issue we will discuss some more on semiconductors, (especially transistors), which will prime us up for next month's project.

Last month we plunged into the area of PN junctions and how their characteristics applied to real devices such as diodes, rectifiers, light emitting diodes and zeners. In our power supply project we will use some of those devices (plus a couple you haven't seen yet). The power supply is a single supply which will provide adjustable output voltage from 1.2 volts DC to about 28 volts DC and has pretty good regulation (a term we'll discuss later). It can source up to 1.5 amps with minimal ripple. If you are following this series and want to do some of the activities we are suggesting this one is relatively easy to build and not too expensive (especially if you can scrounge a few of the parts).

My goal in this project was to keep it simple but useful and buildable without a lot of specialized equipment, so in my version I did not use a custom printed circuit board. I also left out some features which you might want to add later. For example, although I included a simple analog voltmeter and the components necessary to drive and calibrate it, I did not include circuitry to switch the meter to indicate current. Also, a current control adjustment was not included, either. I considered doubling the size and making it a dual tracking supply with digital readouts and a fixed 5 volt supply . . . but you can see what happens. These things tend to get out of control.

I made sure that all of the parts, including the box, meter, etc., can be obtained from your local Radio Shack, or other electronics part supply houses. (Not to give Radio Shack a plug, but because they may be the most accessible for the beginner.) If you were to buy all the parts it might cost about fifty dollars. If you can scrounge some of the hardware and basic parts you could reduce that figure significantly. There is no need to build the supply in such a relatively small box. In fact, if you anticipate adding a few other features or doubling the circuit to make a dual supply, a larger box would be desirable.

Enough! Let's look at this critter. Let's start with the schematic to see how it works. Later we can consider some of the practical aspects of how it was built and why.

Figure 1 shows a schematic of the supply. You will note that the first part of it looks like the example I showed you in last month's article. There are three main sections to the circuit: the unregulated supply which steps down the line voltage, rectifies and filters the DC; the adjustable regulator which keeps the output voltage constant; a light emitting diode used as an 'ON' indicator; and an analogue meter circuit which displays the output voltage.

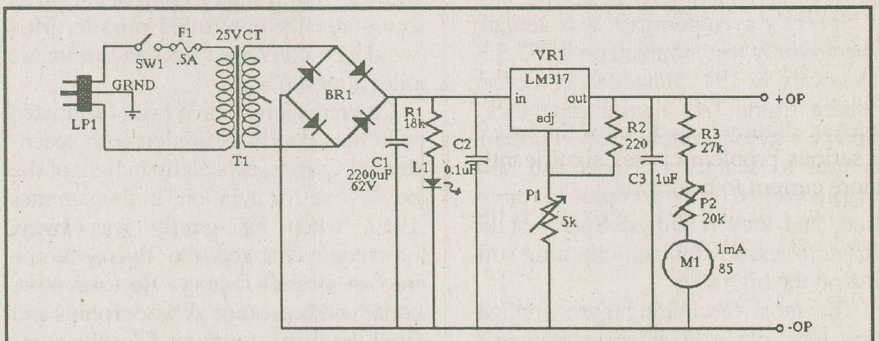


Figure 1. A Variable Regulated Power Supply

How It Works

One hundred and ten volt AC line power is obtained by plugging a three prong plug into your standard home power outlet. From the plug, power is supplied via the line power cord to the on/off toggle switch. The 'hot' side of the AC line voltage is connected to the on/off switch of the power supply to ensure that, when the switch is off, no exposed parts are 'live' and constitute a

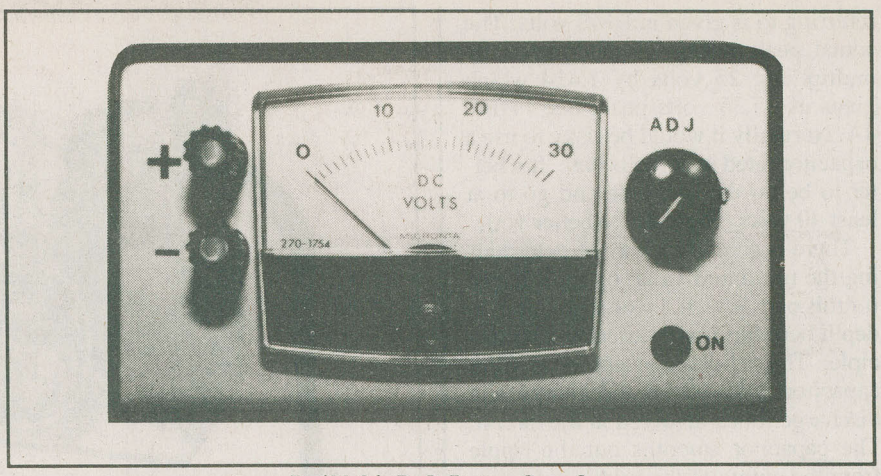
safety hazard. Even so, caution should be taken when power is on as the fuse holder has exposed contacts which are hazardous.

Referring to the schematic again, the next part in line is the fuse just mentioned. Have you ever wondered how to determine the correct current rating for a fuse on the primary side of a power transformer? It's quite simple really. We know from magnetics theory that the turns ratio (ratio of the number of turns of wire on the primary side to the number on the secondary side) determines the factor that the voltage is stepped up or down. In this case we are using a step down transformer to go from 110 volts AC to 25 volts AC so the ratio is roughly 4 to 1. We also know that if a given current is being drawn from the secondary then the current being draw from the power line will be *less* by the same factor of 4. (This also means that the same power (I x V) is supplied to the primary as is dissipated by the load on the output of the secondary.)

So, if the maximum current that this power supply will put out is going to be about 1.5 Amps, (at 25 volts AC from the transformer), then the maximum input current will be about 1/4 as much. That means our fuse should be slightly higher than 1.5/4 which is about 375 mA. I chose to use a 500 mA fuse which allows the supply to exceed its rated current slightly but will blow the fuse if a serious problem causes significantly more current to be drawn.

Wow! All that and we're still at the fuse! Let's push on.

As I said, the power transformer output is 25 volt. In this case we are using a 25 volt *centre tap transformer*, rated at a maximum of 2 amps. If you are new to this, a centre tapped transformer is



Build this D.C. Power Supply

one in which the output coil has a connection brought out from its centre. This allows you to use the voltage output from the top half, bottom half, or the whole coil. If the transformer is rated at 25 volts (RMS by the way) then 12.5 volts will be available across each half. In this case we will not use the centre lead but centre tapped transformers are often used to obtain dual (plus and minus) supply voltages. See Figure 2 for an example of how this is done.

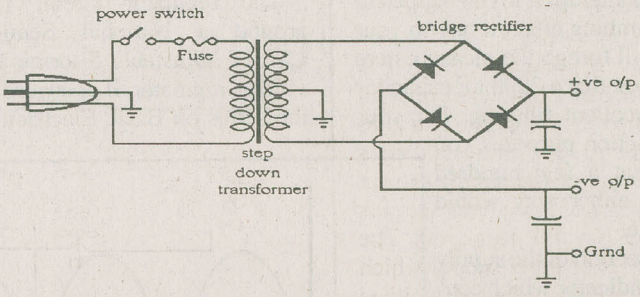


Figure 2. Basic Schematic of a Dual Supply

The output of the transformer is applied to BR1, a bridge rectifier. It is shown here as four discrete rectifier diodes but is physically a single device with four leads exiting it. (See Figure 3) As we discussed last month, the bridge rectifier 'steers' the current so that it always flows out of the bridge with the same polarity, regardless of the polarity of the alternating voltage from the transformer. It is called a rectifier because it is the device which changes AC voltage to DC voltage. Even though we have a form of DC at the output of the bridge it is still *pulsating* DC. This must be smoothed or filtered to obtain the stable DC voltage that we require. This is done by the filter capacitor, C1.

The filter cap is a fairly large electrolytic capacitor (2200 uF) which should have a voltage rating which exceeds the highest voltage which may be impressed across it. (If you exceed that voltage, or if you connect this capacitor in the wrong polarity, the results can be spectacular — it tends to physically explode.) In my power supply I used a cap with a 63 volt rating just because I had that particular one lying around. Sixty-three volts is more than enough. In fact the minimum voltage rating is about 36 volts. This is determined by calculating the maximum voltage possible across it. We said that the output of the transformer was 25 volts and that the bridge converted that to pulsating DC but we must remember that the 25 volts we are

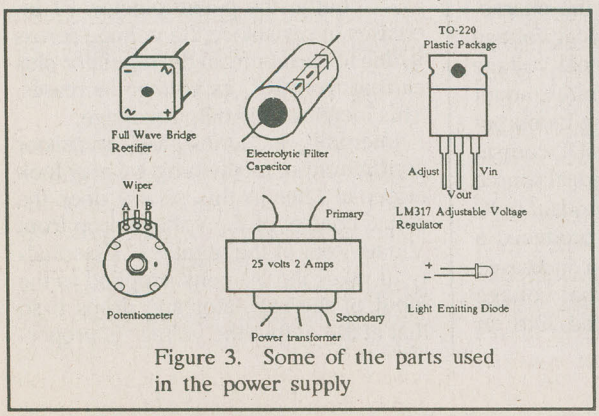
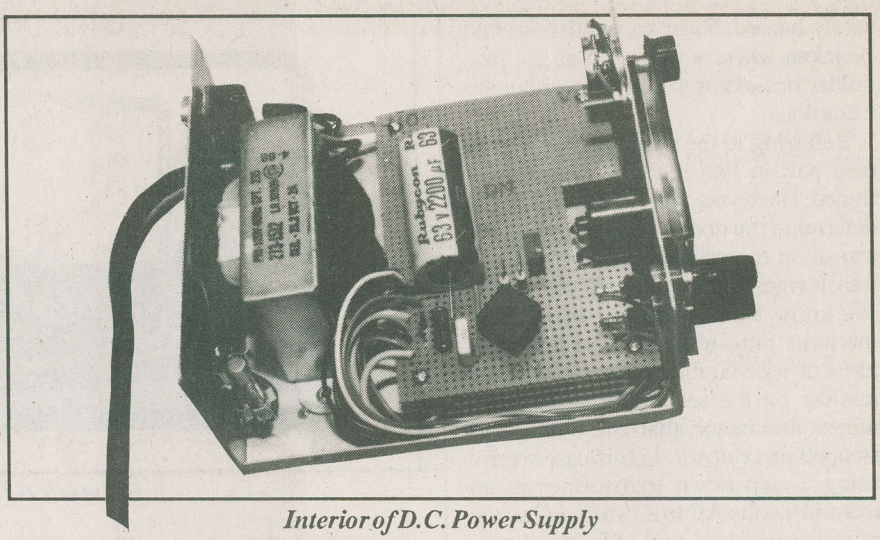


Figure 3. Some of the parts used in the power supply

referring to is given in RMS volts. The actual peak voltage is determined by multiplying 25 volts by 1.414 which gives us 35.35 volts peak. See Figure 4A. Normally it would be risky to use a capacitor rated at 36 volts here. It's better to be on the safe side and go to at least 40 volts (50 might be better yet).

There is actually a way of determining the minimum value of capacitance for this part as well. I won't go into it in depth here but I will describe the principle. The whole concept of a filter capacitor is based on the charge and discharge times involved in the circuit. The capacitor smooths out the ripple from the output of the bridge by charging up very quickly when the bridge output goes positive and discharging more slowly into the load (the rest of the supply and its output) when the bridge output is lower than the voltage on the cap. The value of capacitance must be chosen large enough so that sufficient charge can be stored to supply the output current required without its voltage dropping an objectionable amount. See Figure 4B. This can all be calculated, (and you can attempt it if you happen to enjoy the numbing effect it has on your brain), but I'll forego the pleasure here and assure you that a 2200 uF capacitor will give excellent filtering. For your own construction purposes you may find that a few hundred microfarads either way would be acceptable.

The next section of the supply is the 'ON' indicator which consists of a resistor, R1, and light emitting diode, L1. These are connected in series across the 'unregulated' supply. At this point in the circuit the voltage, rectified and filtered, will be about 30 volts. The LED is connected here rather than at the output because the output will vary between 1.2 and 28 volts, depending how we have set the front panel potentiometer, and this would change the current through the LED. The resistor serves to limit the current through the LED to somewhere in the vicinity of 20 mA (which is the general range of current an LED usually draws). If the DC voltage is about 30 volts, and the forward voltage drop across the LED is about 2 volts, the voltage across the resistor is about 28 volts. In order to limit the current through the resistor and LED to about 20 mA the resistor should be 28 volts/20 mA = 14 kohms. Standard EIA resistor values are 15 k and 18 k. I chose 18 k, (which gives a current of about 15 mA) to keep the current well below the maximum. At this current the brightness of the LED is still acceptable.



Interior of D.C. Power Supply

The regulator circuit is centred around a National Semiconductor LM317 adjustable 3 terminal positive voltage regulator. If you were following the series on Basic Electricity, several months ago we discussed the characteristics of ideal and non-ideal voltage sources. We said that an ideal voltage source would supply an infinite amount of current while maintaining its output voltage perfectly constant. Of course, there is no such thing as an ideal source and we discussed how a non-ideal voltage source, like a battery, produced a nominal voltage but as you increased the current drawn the terminal voltage decreased. The source acted like an ideal source with a low value of resistance in series with it.

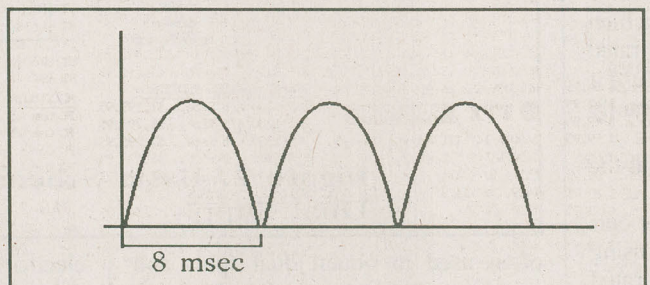


Figure 4A. Full Wave Rectified Waveform

The unregulated part of our supply (which feeds the regulator) would act like a non-ideal voltage source. Characteristics of the transformer and bridge rectifier would simulate the internal resistance mentioned and as the current drawn increased the output would decrease. Furthermore, if the AC line voltage level were to fluctuate, (and it does), the output voltage would also change.

The job of the voltage regulator here is twofold: First, it compares the output voltage to an internal reference and controls the output voltage so that it remains constant, and, second, it provides a method for adjusting the output voltage to the level we want by using a potentiometer. Internally the regulator uses a zener diode to provide a fixed reference voltage of 1.2 volts across the external resistor R2. Because of this the voltage at the output can never decrease below 1.2 volts, but as the potentiometer, P1 increases in resistance the voltage across it, due to current from the regulator plus current from R2, its voltage increases. This increases the output voltage.

Internally a "series-pass" transistor configuration, (something we may look closer at later in this series) does the actual control of the voltage drop from Vin to Vout of the regulator. Essentially, it takes the 30 volts supplied to the input of the regulator and drops it so that at the output the voltage is propor-

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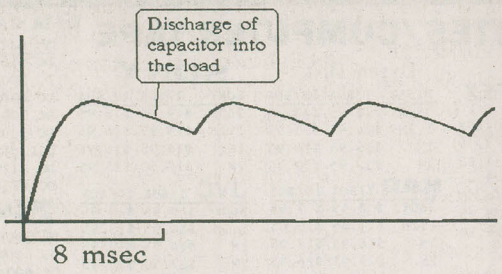

Figure 4B. Filtered Full Wave with Ripple

tional to the voltage of the potentiometer plus the 1.2 volt reference voltage. If the input voltage decreases the regulator senses a tendency to decrease the output and immediately changes the voltage drop across the device to maintain the output where it was before. Also, if additional current is drawn from the output of the regulator, this will tend to decrease the output voltage due to the inherent internal resistance of the supply. As soon as a decrease in output voltage is sensed, again the regulator adjusts the voltage drop across itself to maintain the same voltage as before. Of course, all this happens so quickly and the sensing is sensitive to very minor changes so virtually no change in the output is perceptible.

There are two capacitors, C2 and C3 added on either side of the regulator. C2 is a .1 uF capacitor which is used to decouple transient noise which can be induced into the supply by stray magnetic fields. Usually it is only required if the regulator is far from the filter cap. I added it anyway, although it may not be necessary. C3 improves transient response. This means that while the regulator may perform perfectly at DC and at low frequencies, (regulating the voltage regardless of the load current), at higher frequencies it may be less effective. Adding this 1 uF capacitor should improve the response at those frequencies.

Finally, in order to see what the output voltage of the supply is, we add an analogue meter circuit. The meter movement I obtained had scale markings indicating zero to 15 volts DC full scale reading. On the package it said that the internal resistance of the meter movement was 85 ohms and that with a 15 k resistor in series with the meter, it would indicate 15 volts full scale. If there were 15 volts applied to a circuit with 15 k plus 85 ohms in series the full scale current would be approximately 1 mA. If we want it to indicate 30 volts full scale, (the maximum this supply will put out) we have to limit the current to 1 mA and then change the markings on the scale to read appropriately. At 30 volts we would require about 30 k in series with the meter. In order to calibrate the meter as closely as possible I used a 27 k resistor and a 20 k ten turn potentiometer. (A 5 k pot might have been better but I scrounged this one and it worked fine.)

When connected across the output of the power supply and calibrated using a known accurate meter the meter gives a fairly close indication of the voltage output. Unfortunately this meter movement was slightly non-linear and the specs said it was only accurate to about 2.5% of full scale. This would mean that it could be out as much as .025 x 30 = .75 volts. This is pretty high so the meter on the power supply should only be used as a guideline. For accurate voltage setting you should use a better quality voltmeter.

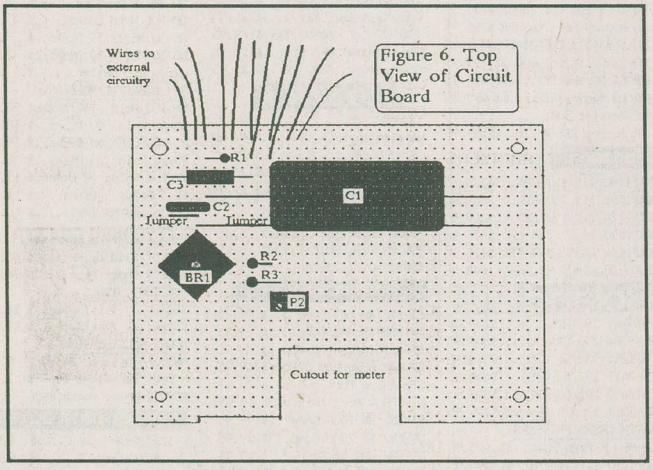

Figure 6. Top View of Circuit Board

Construction

In the construction of my power supply I elected to use a relatively small box as the number of discrete components was low. In your case you may want to use something you have available, or you may want a larger box to accommodate more circuitry to implement a negative supply as well. If you can obtain a box made of soft aluminum it makes construction a lot easier. Not only is drilling holes simplified but if you need to enlarge or shape them, (as you do with mounting grommets, potentiometers, banana jacks and the meter movement), this can be done much more easily.

I scavenged a power cord with a three prong plug from another project and found a grommet which would provide some strain relief for the cord. It is important that you do connect the green ground wire from the cord (which is connected to the plug's third prong) to the chassis of the supply. This is a safety measure in case the chassis accidentally comes in contact with the 110 volts AC. The current will flow to ground through the cord instead of through you. I also scrounged a toggle switch which happened to have leads instead of terminals which was good because I could connect to the line cord using small Marr connectors and not have an exposed hot wire inside the chassis. I mounted the switch on the rear panel of the box so

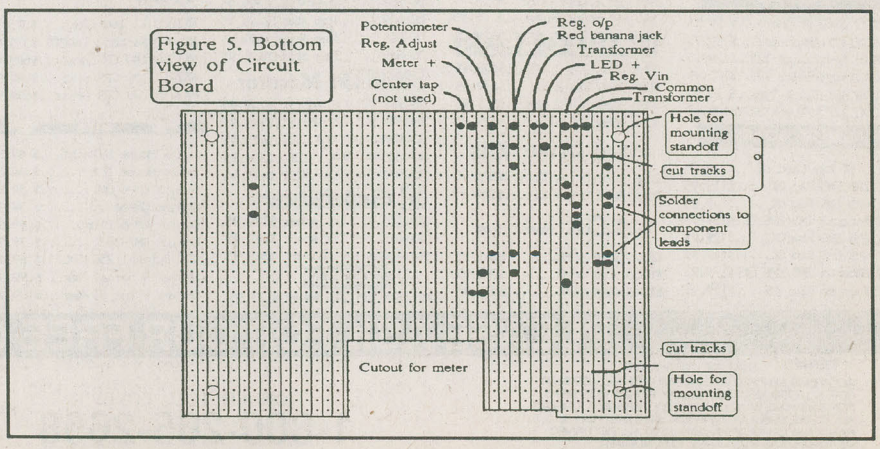

Figure 5. Bottom view of Circuit Board

the cord instead of through you. I also scrounged a toggle switch which happened to have leads instead of terminals which was good because I could connect to the line cord using small Marr connectors and not have an exposed hot wire inside the chassis. I mounted the switch on the rear panel of the box so that AC would not have to be run to the front and back to the transformer. Remember, if you build this project: **BE CAREFUL.** Always unplug the AC line cord when working inside the chassis. If you are troubleshooting the power supply use one hand only whenever possible to minimize the possibility of getting a shock.

The fuse holder I used was a small clip type which was also mounted on the rear panel. This type of fuse holder is not as safe as I would have liked it to be as the contacts are exposed and voltage is present if the on/off switch is on. The alternative is to use a cylindrical fuse holder which allows external access from the rear panel and can be more easily insulated with heat shrinkable tubing. The one I used just happened to be available. (I was also concerned that the other kind might take up an objectionable amount of room.)

After mounting the power transformer in the rear of the box using pop rivets I proceed to drill all the holes for the adjustment pot, LED and banana jacks. The banana jacks should be 2 cm apart.

The circuit board is made out of a product called Veroboard. Generic versions are available at parts supply houses. This is a phenolic printed circuit board with copper strips on one side. It is predrilled on .25 cm centres so that you can insert component leads through the board, solder them and have them connected to any other component soldered to that strip. See Figure 5. If you want to isolate one part of a strip from another it is a simple procedure to cut the copper using a knife or to use a drill bit to cut the track around the holes. In my version I mounted the components on one side of the board so that I could add circuitry later if I wished. See Figure 6. All the wiring from the board to other parts of the circuit were connected near the same end so that I could fold out the board for access to its underside and other components in the box. The 3 terminal regulator was mounted on the bottom of the box to make use of the metal box as a heatsink. Leads were run from it back to the circuit board. It is important to know that the metal tab on the regulator is connected to the output pin of the device so it had to be isolated from the metal box using a mica insulator and a special isolating washer for the machine screw which fastened it to the box. White heat sink compound was used to maximize the heat transfer from the device to the box.

Because the meter movement was something of an afterthought I had to cut a notch out of the circuit board to accommodate the rear of the meter movement. I used a nibbler tool for this as well as to cut out the hole in the front panel for the meter movement. To mount the circuit board I used 2 cm standoff hardware making sure that the metal standoffs did not short out any of the copper strips which were being used.

Well, there it is. When you are just starting out on a project like this you may not have some of the tools and possibly you are not aware of a few of the tricks. Hopefully, some of the details here will have been helpful. In future segments we'll use this unit to check out some other interesting circuits. ❐

Sperry, *cont'd from page 11*

guidance systems, long-range aircraft and submarines. Instead of mounting two stabilizers separately, as he had earlier, he nested four gyros on a single platform. The gyros established a stable reference and servos aligned the airplane with the reference.

Sperry used a combination of electrical, mechanical and pneumatic components to align the airplane automatically with the horizontal stable platform. When the airplane went into an error state — when it deviated from the horizon —the relative movement between the stabilized platform and the airplane initiated a command signal that operated the servomotors, which moved the airplane's control surfaces.

The stabilizer also had control surfaces so that the airplane would not pass beyond the horizontal in its response.

"Sperrys have made aeroplanes safe," the New York Times reported in June, 1914, after a public demonstration of the stabilizer in Paris. And although needing refinement, his stabilizer had, indeed, made the skies more friendly.

Increased research and the production of dozens of inventions made Sperry a corporate head. But one suspects most of Sperry's dress shirts still carried the odd drop of grease or smell of solder. Like most hobbyists, Sperry's mind never ceased to whir with innovation. New Yorker Magazine profiled Sperry shortly before his death in 1930. Ill and ordered by his doctor to stay away from machine shops for health reasons, he nevertheless penned gizmos which he sent to his engineers. He also added, whenever inspiration hit him, to an "ever-present notebook" — No. 78 by the time of the article. Hours before he died after complications from an operation on June 16, he was still inventing. Sperry placed ice before an electric fan to create a cooler breeze beside his hospital bed. ❐

FEATURE

University of Toronto Research

What Makes a Research University Great?

Greatness in a research university is signalled by many factors. Each plays an integral part in ensuring that the institution reaches its full potential. Inside, there are bright, dedicated scientists and scholars. There are sophisticated research tools that facilitate the exploration of new and enduring questions. There is an intellectual climate that nurtures the development of ideas and debate. These are opportunities for collaboration, so that researchers can apply their individual expertise to broader fields and issues.

Outside, there is a widespread respect for the quality of the institution's research and scholarship, which attracts other productive minds to the university. There are strong working relationships, both nationally and internationally, with other institutions, so that the university is able to draw upon the resources and insights of others. Finally, there is support from all sectors of the society that the research university serves — support which enables the intellectual enterprise to flourish. Great research universities have committed scholars, modern facilities and links with centres of excellence around the world. Above all, they have impact. They provide knowledge for the economy, ideas for society and leadership for all who explore and question.

From the Microscopic to the Astronomic

Our world is composed of a complex fabric of inter-related systems, ranging from the microscopic to the astronomic. Understanding how these systems function and interact not only allow us to tap the bounty they contain, but also enables us to preserve these systems from overuse and pollution. At the University of Toronto, research into the physical world encompasses virtually all areas of study including astronomy, physics, chemistry botany, environmental studies, mathematics and zoology. University scientists are pursuing a myriad of projects ranging from examination of galaxies millions of light years away, through inquiries into the nature and behaviour of subatomic particles to using mathematical models to explain demographic changes and applying the techniques of genetic engineering to the production of heartier forms of plant life. In hundreds of areas of inquiry, there is a determination to develop new research techniques and a desire to share knowledge with others, so that questions can be answered and learning further advanced. One University scientist's early interest in surface chemistry was applied to work with lasers which ultimately led to advanced techniques in laser surgery. In another area, researchers are collaborating on projects in medical biophysics which apply basic knowledge developed in physics laboratories to hospital-based studies of how the human body functions. The University's scientists are using chemistry and genetics in projects in forest biology which can lead to improvements for the Canadian forest industry.

A Brief History of the University of Toronto

1827 A university of the Province of Upper Canada is founded by Royal Charter under the name of King's College.

1850 By an act of the legislature, King's College is secularized and its name changed to the University of Toronto.

1866 The University of Toronto opens the first Department of German in North America

1878 Professor James Loudon sets up the first under-graduate physics laboratory in Canada.
John Galbraith, the "father of professional engineering in Canada," becomes the University's first Professor of Engineering in the School of Practical Science

1889 The University awards the degree of Doctor of Dental Surgery to 25 students, the first such degrees to be given outside the United States.
H.E.T. Haultain graduates in engineering. His later inventions — the superpanner, the electric mine hoist and the infrasizer in ore-dressing — would be used around the world

Meanwhile, the Institute for Environmental Studies is working on projects to protect rainforests, improve water quality and counter the impact of acid rain. Unravelling the mysteries of the physical world not only allows us to enjoy our earth's fragile treasures, but also enables us to preserve its abundant potential for future generations.

Examining the Human Organism

The life sciences have been a forum for enquiry and experiment since the beginning of recorded time. Understanding the human body, and how to care for it, has engaged some of the world's keenest intellects. Today, with sophisticated research techniques and tools, the potential for developing new knowledge and understanding is unprecedented. With one of the largest medical research complexes in North America, the University of Toronto is able to carry out research in every field of health science.

Through its network of 11 teaching hospitals such as The Hospital For Sick Children, Mount Sinai Hospital and The Ontario Cancer Institute, there is an extensive pool of talent investigating health, disease, and treatment. Their work ranges from basic science laboratories to operating theatres to clinics around the world. The University's research endeavours span collaborative studies in neuroscience that have produced insights into Alzheimer's disease and other neurologic disorders, innovative research in medical genetics that has made major strides in understanding cystic fibrosis and muscular dystrophy, and innovations in transplant surgery that allowed the world's first successful single lung transplant. The social and cultural aspects of health are also research priorities. A project in the Faculty of Nursing, for example, is looking at how to motivate children into "healthy" decision making, while cooperative research in the Division of community health is aiding in the development of more effective health policies. A critical mass of research resources at the University of Toronto enables scientists to conduct investigations that would not be possible in smaller centres. The Positron Emission Tomography scanner at the Clarke Institute of Psychiatry

1901 The University of Toronto Press is established. It is destined to become one of the ten largest university presses in North America.

1907 The University of Toronto establishes Canada's first Faculty of Forestry.

1908 Dr. Charles Wright graduates. During World War I, he would invent the 'trench wireless' and in World War II help develop radar. He would be a member of the Scott Expedition to Antarctica and discover his leader's body.

1909 Canadian farmers receive the first shipment of Marquis wheat. Developed by a University graduate, this variety matures early, thus avoiding frost damage.

1910 Economics graduate Stephen Leacock publishes *Literary Lapses*, followed by *Sunshine Sketches of a Little Town*.

1912 The Royal Ontario Museum is established as part of the University of Toronto covering archaeology, palaeotology, mineralogy, and zoology. Professor Charles Currelly is appointed Director of Archaeology and over the next 35 years establishes the Museum as a major force in that field.

1914 John Gerald FitzGerald, Professor in the Faculty of Medicine, establishes the anti-toxin laboratories, which subsequently becomes the Connaught Laboratories.

1917 University engineer John H. Parkin builds a four-foot wind tunnel, which is used to design aircraft for forest patrol, firefighting, aerial surveying, and mail and passenger service.

1918 Dr. C.K. Clarke, the University's first Professor of Psychiatry, becomes the first director of the forerunner of the Canadian Mental Health Association.

1920 Harold Adams Innis, political economist and pioneer in communications studies, joins the Political Economy Department.
E.J. Pratt, one of Canada's foremost poets, begins teaching English at Victoria College.

1921 Working in a University laboratory, Federick Banting and Charles Best are the first to obtain insulin in a form consistently effective for treating *diabetes mellitus*. In 1923 Banting would receive the Nobel Prize.

1922 The first helium liquefaction plant in North America is set up by John McLennan, who had received the first doctorate in physics from the University in 1900.
Dr. Robert McClure graduates in medicine and goes to China as a medical missionary. He would be the first to treat cancer with radium in China

1924 Reynold K. Young joins the Department of Astronomy. He would later help to design the 74-inch telescope at the David Dunlap Observatory, copies of which are mounted in Egypt, South Africa, Japan and Australia.

1926 Philosopher Etienne Gilson joins St. Michael's College. He would become a founder of the Pontifical Institute for Medieval Studies, one of the world's major centres for the study of Medieval Europe.
Dr. Archibald Huntsman, a University graduate, begins research into preserving fish through freezing, a project which later leads to the frozen food industry. "Ice Fillets" are first sold in Hamilton in 1929.

1927 Edward S. (Ted) Rogers, a University graduate brings the world's first batteryless broadcasting station into operation. It would later become CFRB.
Donald Creighton joins the Department of History. He would eventually win two Governor-General's Awards for his biography of Sir John A. Macdonald.

1929 Dr. Davidson Black, a medical graduate, discovers the skull of "Peking Man," an important clue to the nature of human ancestors.

1930 Drs. Frederick Tisdall, Theodore Drake and Alan Brown, of the Faculty of Medicine, announce the creation of the infant cereal, "Pablum."

1932 Eli Franklin Burton becomes head of the Physics Department, later leading the team that would build the first electron microscope in North America.

provides scientists from a wide variety of disciplines with an extremely powerful tool for research and diagnosis. Life sciences research at the University of Toronto has a powerful influence on the health of people around the world. Due to the global significance of the work, its scientists are keenly aware of the need to collaborate with colleagues from other research institutions, industry and government.

Probing Social Structures

From the earliest civilizations, the relationship of people to their society has been a major focus of research and scholarship. From their different perspectives, philosophers, economists, social scientists, legal scholars and historians have all posed questions about the origin and nature of social structures and about the individual's place within them. Research in this area is carried on at the University of Toronto by one of the largest multi-disciplinary congregations of scholars in North America. Their investigations are providing insights into the past and future of modern society, including studies about the dynamics of population change, the evolution of the family, the interaction of cultures, the planning of urban communities, and the development of economic and political systems. The University's political scientists are carrying on research in such areas as Canadian attitudes toward human rights. Its legal scholars are exploring the effectiveness of rewards and sanctions in traffic safety. Its economists are developing effective models for economic forecasting. Its criminologists are working with law enforcement groups to assess their members' performance. One focal point for collaborative research is the new Ontario Centre for International Business. A provincial Centre of Excellence, it will encompass research in management, law, languages and cultures with a focus on specific geographical areas. Another focus is the *Historical Atlas of Canada*, a national collaborative project which combines research in history and geography to provide a fresh look at Canada's development. University of Toronto researchers are also collaborating on editorial projects such as the 33-volume

1933 Under the direction of Dr. Charles Best, a University-based research team begins work on heparin, an anti-coagulant, which would open the fields of vascular surgery and renal dialysis.

1935 University physicist John Cunningham McLennan is knighted for outstanding accomplishments in research including the discovery of cosmic rays.

1936 Medical graduate Norman Bethune, later a hero of the People's Republic of China, organizes the world's first mobile blood transfusion unit in Spain.

1939 Paul B. Dilworth and Winnett Boyd, who would later develop Canada's first jet engine, graduate from the Faculty of Applied Science and Engineering

1940 Charles N. Cochrane of the Faculty of Ancient History publishes his major work, *Christianity and Classical Culture*.

1942 Dr. Wilbur Franks, a medical graduate, develops the "anti-blackout" suit. Credited with saving thousands of Allied fighter pilots during World War II, his invention would be worn by every air force pilot in the world and eventually be developed into the space suit worn by astronauts.

1943 The first edition of Professor J.C. Boileau Grant's *An Atlas of Anatomy* is published.

1944 A.S.P. Woodhouse becomes head of the Department of English at University College. Over the next two decades he would have a major impact on literary criticism and humanities research in Canada.

1945 Engineering graduate John L. Orr develops a method of removing ice and frost from aircraft parts that is still used my many major airlines.
Dr. Raymond Parker of the University's Connaught Medical Research Laboratories discovers a defined chemical nutrient medium in which cells can grow and replicate. His discovery helps Jonas Salk to develop the polio vaccine.

1946 J. Tuzo Wilson becomes Professor of Geophysics. Responsible for producing the first glacial map of Canada, his greatest contribution would be his explanation of plate tectonics.

1948 Dr. W.G. Bigelow of the Faculty of Medicine begins studies of hypothermia as a means of performing open-heart surgery. Later, he would be part of the team that designs the first electrical cardiac pacemaker.

1951 The University of Toronto installs one of the world's biggest computers, the FERUT.

1956 Clarence Augustus Chant dies at age 91. Often called the "father of Canadian astronomy," he taught at the University of Toronto from 1891-1935.

1957 Surgeon Robert Salter designs an operation to correct congenital hip dislocations, known as the "Salter operation."
English Professor Northrop Frye publishes *Anatomy of Criticism*, establishing him as one of the world's leading literary critics.

1959 The University of Toronto opens the first electronic music studio in Canada, the second in North America.
Work begins on *The Dictionary of Canadian Biography*, which chronicles the lives of influential Canadians. Considered the most ambitious venture in Canadian publishing history, its editor, Francess Halpenny would receive the Molson Award in 1983.

1962 Harold E. Johns establishes Canada's first Department of Medical Biophysics. He would be best known for developing cobalt therapy units which revolutionized radiation treatments of cancer around the world.

1963 Robertson Davies becomes the first Master of Massey College. In 1970, he would publish *Fifth Business*, the first volume of his *Deptford Trilogy*.
Dr. W.T. Mustard of the Faculty of Medicine perfects his surgical method for correcting the "blue baby" syndrome.

1964 Professor Marshall McLuhan publishes *Understanding Media* and becomes internationally known for his studies of the effects of mass media on thought and behaviour.

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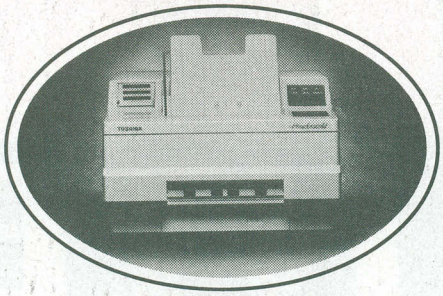

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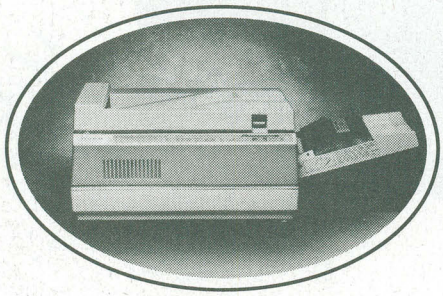

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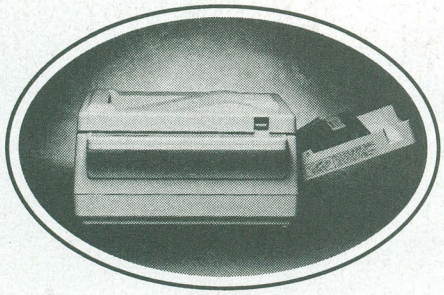

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Small, fast and easy to use, the PageLaser 8 is pleasingly undistinguished.

Steve Rimmer

No one really wants exciting peripherals. A laser printer which spits toner, shreds its pages or changes emulation modes erratically may serve as an interesting topic of conversation, but it's not a particularly useful tool to get anything do anything productive. The Page Laser 8 from Toshiba is a particularly unexciting laser printer in this regard. It prints when it's told to and otherwise seems to keep its thirst for adventure to itself.

The most notable feature of the PageLaser 8 is its size, or perhaps more properly its lack of size. A bit larger than a monitor, it will occupy a minimum of desktop real estate. It's also fairly light.

The PageLaser 8 features LaserJet emulation; it can be driven by most applications which will deal with a Hewlett-Packard LaserJet Plus. Note that this is not equivalent to a LaserJet series two or three printer, both of which offer substantial extensions to the basic PCL printer standard that the PageLaser 8 supports.

The PageLaser 8 comes with a megabyte and a half of memory, which is fairly generous for a LaserJet emulation. The extra memory is useful for such things as storing lots of downloadable fonts, a condition common in desktop publishing, and for use as a data buffer.

One of the rather more civilized aspects of the PagePrinter 8 is its choice of interfaces; it comes with one parallel and one serial port. Furthermore, you can switch between them with a few keystrokes from the printer's front panel; the basis of simple printer sharing if you can't come up with anything more sophisticated.

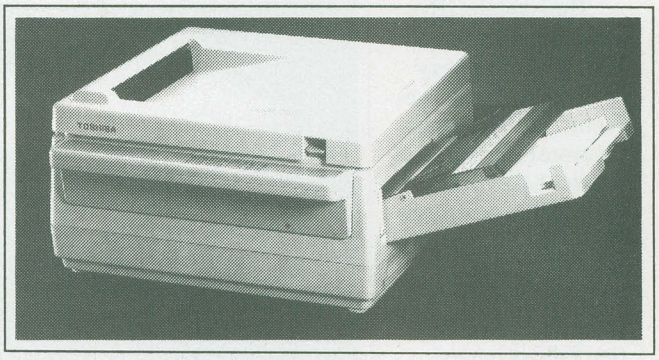
The front panel of the PageLaser 8 consists of a liquid crystal display and eight membrane switches. The liquid crystal display allows you to step through a menu which selects the various options available to the printer: the default font settings, the interface and so on. The menu is fairly well set up. Unlike some of the more immense multiple emulation printers, the PageLaser 8 doesn't have that many options to worry about.

If there's one thing missing from the PageLaser 8's front panel it's a backlight for that liquid crystal panel. It's fairly deep in the plastic and a real pig to read under anything but ideal lighting conditions. Chances are this won't actually matter to you once you've set the system up, as in most applications you won't have recourse to the front panel in the daily use of the printer.

Another minor complaint about the PageLaser 8 is that its configurable input data buffer — a grand idea, this — can only be expanded to 99 kilobytes, presumably because the numeric field on the display is most comfortable with a maximum of two digits. If you're using the printer to output straight text pages, most of its megabyte and a half of memory will never be used for anything else and it would be convenient to be able to configure it as a buffer.

The PageLaser 8 is based on a system of two replaceable components: the toner cartridge and the photoconductor drum. This improves the economy of the system over single package designs, which usually have you replacing the expensive photoconductor drum far more often than is necessary. One drawback to the PagePrinter 8 implementation, however, is that part of the photconductor is exposed to light when you open the top of the printer. If it's exposed long enough you'll get to learn about photconductor replacement prematurely.

In operation, the LaserJet emulation of the PageLaser 8 proved pretty stable. It seems to have some problems with the current LaserJet driver for Windows 3, but I'm more inclined to blame this on the driver than on the PageLaser 8. Nothing else which I used to drive it with exhibited the same difficulties. Unlike many LaserJet emulation modes, the PageLaser 8 is quite fast. Note that there's a difference between a fast engine and fast firmware to drive it. For example, the PageLaser 8 handles LaserJet macros unusually quickly, something which has traditionally been a bottleneck for many low end lasers.



The engine for the PageLaser 8 is better than average. It produces crisp type and large grey areas which are reasonably clean and consistent. Of course, I got a brand new printer to try out; the quality of a laser printer engine only seems to really show when you've had it running for a year or two.

As small, simple laser printers go, the PageLaser 8 is not at all shabby. It does what it's intended to do and does so quickly and with a minimum of fuss. One would be hard pressed to complain about something so uncomplicated.

For more information contact:

Toshiba ISG
191 McNabb Street
Markham, ON
L3R 8H2
1-800-387-5645

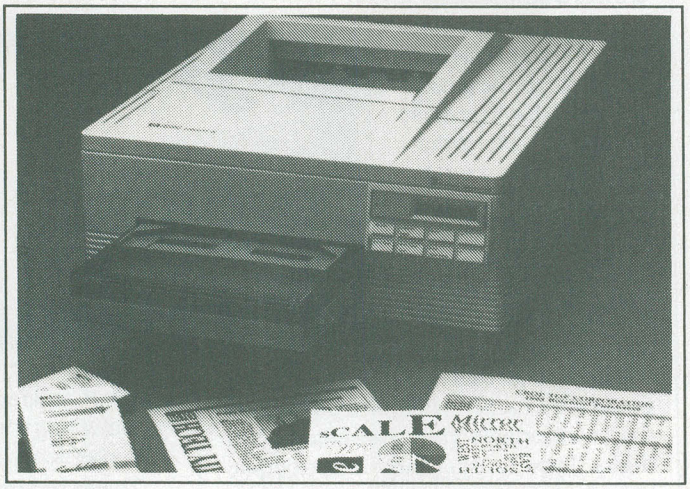
THE HEWLETT-PACKARD LASERJET III

Printer power without the price

Frank Lenk

Considering the popularity of the Hewlett-Packard LaserJet II, it seems almost unnecessary to say anything about its successor, the LaserJet III. However, there's much that should.

One of the strengths of the LaserJet II was its simplicity. It laid its pages out as simple bitmaps, and accepted bitmapped fonts either downloaded from your computer or in handy cartridges that you could plug into the printer itself. The printer's reliability and longevity have become legendary.



The LaserJet III is everything that the II was, with some very well-chosen improvements. The styling is a bit more futuristic, and the front-panel controls a bit easier to use. However, the most significant addition is Hewlett-Packard's proprietary Resolution Enhancement technology. This gives the LaserJet III an effective resolution far better than the nominal 300 dots per inch it shares with virtually all other laserprinters. Although the LaserJet III still only places 300 dots per inch, it can control the precise positioning and size of those dots. This allows it do a lot to smooth the "stair-step" diagonal edges that are otherwise inevitable in a rectilinear bitmap.

The upshot is that output from the LaserJet III looks a lot more like 600 dpi than 300. It's far and away the best-looking print you can get, short of typesetting gear that sells for many tens of thousands of dollars.

The other major change in the LaserJet III is the upgrade of its internal control "language", PCL (printer control language). The current version, PCL-5, adds support for scalable fonts, greatly reducing the amount of hard-disk space required by fixed-size, LaserJet II bitmapped fonts. (You can still use the older fonts, if you wish.) It also provides better graphic support, by incorporating the HP-GL/2 graphic language.

HP-GL originated on Hewlett-Packard's plotters, and has become a strong standard in the field of computer-aided design. Considering this heritage, it comes as no surprise that HP-GL/2 is strong on geometric drawing and pattern fills, but weaker than PostScript on typographic control. PCL-5 as a whole is also much less of a programming language than PostScript, so it can't take over as much of the page-layout work from your computer.

PCL-5, unfortunately, is still not as well supported by application software as it ought to be. However, support is building steadily, and the next wave of new software releases will probably be fully up to speed.

Of course, if you want ultimate control and compatibility, there are now several ways of adding PostScript capability to your LaserJet III. Hewlett-Packard does a cartridge containing genuine Adobe PostScript; it's a bit pricey, but gives impeccable compatibility and print quality. The major competitor is Pacific Data Products, with a new version of its PacificPage P*E that compares well with the HP cartridge, at a much lower price. Take note that any form of PostScript will want lots of memory; figure on expanding your printer to at least 3 megabytes, and get more if you can.

Even if the LaserJet III weren't a superb printer, it would still be desirable -- for much the same reason that the IBM AT, never the hottest computer in creation, was a highly attractive purchase. It's a standard.

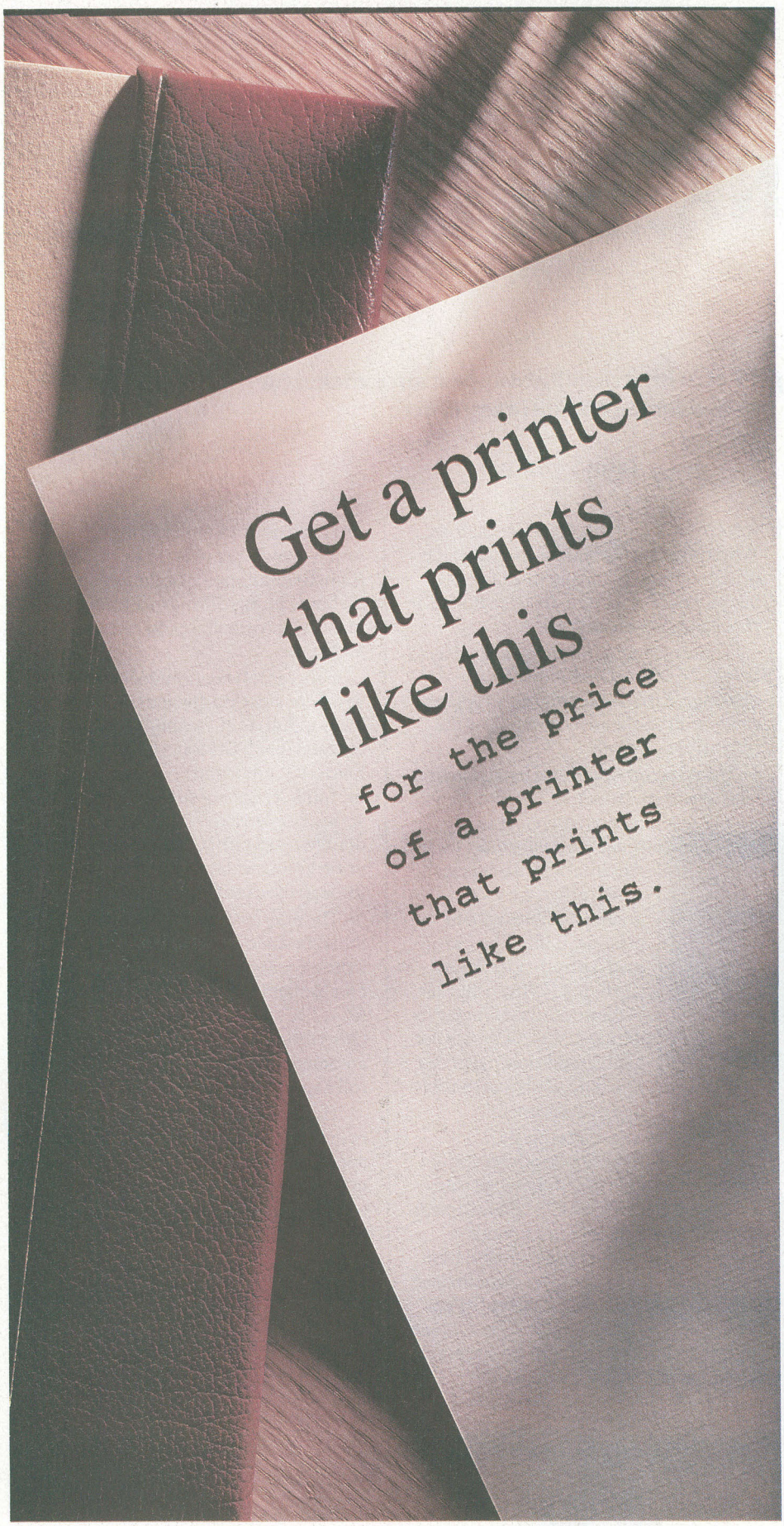
Not only is the HP III a standard unto itself, it's based internally on the strongest standard in laser printers -- the redoubtable Canon laser engine. Canon toner cartridges are easy to deal with and easy to find. Canon print quality -- even without HP's own Resolution Enhancement -- is top-notch, with velvety blacks and crisp, uniform text. Rated printing speed is eight pages per minute.

Unbelievably, the HP LaserJet III is one of the least expensive printers in its league. (About the only ones that are cheaper are the much slower 4 page per minute types.) Even if you bypass the regrettably sizable gray market, you should be able to pick up the LaserJet III from a legitimate HP vendor for not much more than about twenty-five hundred dollars. Add some memory and a PostScript cartridge, and you've got just about the cheapest PostScript printer on the market.

There are a lot of other excellent laser printers out there. However, for all-round performance and versatility, Hewlett-Packard is definitely setting the pace.

For more information contact:

Hewlett-Packard (Canada) Ltd.
6877 Goreway Drive
Mississauga, ON
L4V 1M8
(416) 678-9430



Before now, anyone who had less than $1,000 to spend on a printer got inferior print quality for their money.

But times have changed. Because if you have the price of a dot matrix printer, you have the price of the new Hewlett-Packard DeskJet 500.

Its output looks like it came from a laser printer costing thousands of dollars. But it lists at just $989. (And dealers may sell it for less.)

The HP DeskJet 500 gives you a lot more than you'd expect for the price. Including compact size. Quiet operation. Graphics and text at 300 dpi. And a comprehensive three-year warranty.

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STAR NX-1020 REVIEW

Stylish printer, with streamlined appearance, makes for welcome addition to any office.

John Swinimer

Remember the days when printers were big unwieldy devices taking up half your desk? They were noisy and took half the day to print. Well, those days are over to make way for new and more efficient printers.

The Star NX-1020 is designed for today's working office environments. Its stylish design and sleek appearance will suit any office desk. This dot matrix printer offers high-quality performance with easy-to-use controls for instant printing capabilities. Weighing almost 14 pounds, the printer can be moved from office to office if desired.

Printer features are uniquely designed to provide ease of use and appealing appearance. Some printers make the user search for some time trying to find the power switch. The NX-1020 is located directly at the left front of the unit for ease of use. The control panel, located on the front right of the unit offers five buttons. When pressing the buttons to change the printer settings, indicator displays and beep tones reveal immediate feedback for precise printer conditions.

The removeable top cover lifts away to reveal the printer head and ribbon-cartridge. Ribbon cartridges are replaced easily with one hand by pressing on the ribbon release catch.

Users have the option of using friction feed or push/pull tractor. The removeable rear cover conveniently hides the tractor unit. Another design feature, which offers the user greater flexibility when printing, is the ability to load fanfold paper. Paper can be loaded from the rear of the printer and is aided by the mechanics of the tractor feed. In addition, paper can also be loaded from the bottom of the printer.

Supporting the IBM/Epson printer commands and character sets, the NX-1020 is able to print from most computers and software programs. The printer has two emulation modes. Standard mode offers functions of the Epson FX-850 or EX-800 for colour print. The NX-1020 provides good colour images and works well with any graphics type application. In IBM mode, the printer emulates the IBM Proprinter III. For those who want to change system settings and print commands, the detailed user's manual provides information on Switch Combination Settings Functions, Default Settings, Printer Control Commands, Downloading Characters and more.

Fonts are always a major concern when considering a printer. The NX-1020 has one draft font, one high-speed draft font and four NLQ fonts (Courier, Sanserif, Orator and Script). In addition, the fonts are enhanced by italics for all styles, condensed print, bold print, double-sized print and quadruple-sized print. Fonts can be easily changed through the use of the control panel.

The interface connector is located on the right side of the printer towards the front. A centronics parallel interface comes standard with the unit, however, a RS-232C serial interface is optional. Other options for the printer include an automatic sheet feeder (SF-10DN) and roll paper handler (RH-10Z).

The Star NX-1020 is a unique dot matrix printer. The combination of a sleek appearance and high quality performance makes the printer a valuable asset to any office or desktop for efficient results.

For more information contact:
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35 Ironside Crescent
Scarborough, ON
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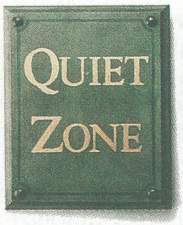

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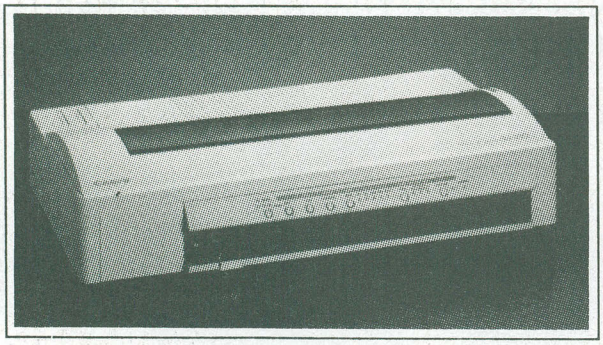
CANON BUBBLE JET BJ-330

New printing technology offers a happy medium between dot matrix printers and laser printers.

John Swinimer

Somewhere between the low-end dot matrix printer and the high-end laser printer lies the new printer from Canon. A new technology has allowed users to economically afford printing with near laser-type quality but also dot matrix user-friendliness.

The bubble jet printing system fires ink droplets at the paper from thin nozzles. Ink in the thin nozzles is heated to such a degree that it creates bubbles. The ink droplets are ejected onto the page as the bubbles disappear through vapour condensation. Overall the effect creates high print quality of 360 dpi resolution. The ink jet speed is remarkably fast at 300 cps in high speed mode while managing 150 cps in high quality.



In addition to this innovative printing technology, this printer is quiet too. Unlike the dot matrix printers which actually beat the ink into the paper, the BJ-330 sprays the ink onto the page through the nozzles. The acoustic level is about 45 decibels. In a regular office environment, the only sound heard from the machine is the tractor feed.

The BJ-330 is similar in most respects to its sister printer the BJ-300. The main difference lies in the width of paper handling. While the BJ-300 can handle cut sheet paper up to 11.7 inches wide, the BJ-330 handles cut sheet paper up to 17 inches wide. This wider use of paper may suggest the printer be used for CAD/CAM or plotting purposes.

Due to the availability for extra wide paper handling, the printer takes on an elongated design. The power switch is located at the right side towards the back of the unit. The front control panel offers seven buttons and lights. These buttons are used to set the printer on and off line, set modes, select fonts, select pitch, select paper source, initiate head cleaning and more.

Located just below the control panel is an opening for cut sheet paper. A cut sheet paper guide allows any width of paper to be inserted. An optional automatic sheet feeder and paper delivery tray accepts cut sheet paper from the back of the printer.

The top back of the printer has been left exposed for easy access to sheedfed use. Pin-feed wheels can be set at any width to suit user's needs. Unlike some dot matrix printers, no sheet opening is available underneath the printer. Fan fold paper is accepted easily from the rear of the unit.

At the top left rear of the unit, there are two slots for font cartridges and RAM expansion cards (both cards are optional). Standard fonts include Courier, Prestige and Gothic.

A parallel interface connector is located at the rear of the unit. An optional serial interface board (BJIF-3020) is available for other connecting purposes. A cut-away panel has been provided if the serial interface is to be installed.

The printer has two emulations: IBM Proprinter XL24E and the Epson LQ1050. It functions very well with spread sheets, graphics, data processings and word processing functions. Printing at 136 columns, the BJ-330 offers 30KB for the input buffer.

With any new technology comes new responsibilities. Such is the case of the printer cartridge with the BJ-330. While similar to the toner cartridges of laser printers, the ink cartridge is not as cumbersome or as large. Users can conveniently change ink cartridges by way of a front flap located at the front left of the unit. An indicator light blinks on the control panel when the time comes to change cartridges. Users simply remove the old cartridge and insert the new cartridge without any hassles.

A well documented manual is included with the unit. Users can refer to any printer function or installation procedure in English or French with ease.

The Canon BJ-330 offers quality printing with low noise results. For users wanting near-quality laser printer results with dot-matrix user-friendliness in addition to extra wide paper handling, the BJ-330 will suit their needs.

For more information contact:

Canon Canada Inc.
6390 Dixie Road
Mississauga, ON
L5T1P7
1-800-848-4123

CANON LASER BEAM PRINTER LBP-4

Compact, desk-sized laser printer offers low-volume printing with high quality output.

John Swinimer

The past few years have seen numerous developments in the field of laser printers. One of the many exciting improvements to come along is that of reduction in size. The Canon LBP-4 boasts the advantage of sitting comfortably and relatively unnoticed on many office desks.

In appearance, the Canon LBP-4 could be compared to the Apple Personal Laserwriter. Printing at four pages per minute, the LBP-4 offers a front fold down tray revealing a cut sheet paper feeder tray, a paper delivery selector, and a release button for internal viewing and EP-L cartridge replacement. The Apple Personal Laserwriter places the release button on the outside of the machine while the LBP-4 discretely covers the release button preventing accidental exposure of the photosensitive drum to light.

Below the front panel for the paper feeder tray is a place for an optional cassette paper feeder. Cassettes are available for various types of paper sizes. Each cassette holds up to 250 sheets of paper making this option handy so users needn't be bothered by inserting paper every time they go to print.

The printer provides two types of paper paths. In tray feed mode, paper is manually inserted and outputs to the top face-down tray or the face-up tray located on the multi-purpose tray. In the optional cassette feed mode, paper is automatically chosen from the cassette at the bottom of the feeder and delivers paper in the same fashion as the tray feed mode.

The power switch is located on the right side of the printer towards the rear. Users are given their choice of interfaces with this printer. The LBP-4 provides serial, video and parallel video connectors, all inset in the rear of the printer.

The control panel, located at the top front of the printer, provides a combination of lights, LCD display and keys. This control panel was easy to use and understand. Key functions include online, form feed, error skip, test/font, reset enter, menu, and feeder select. The LCD display was so intelligent that it even knew what software package was being used as information was sent from the computer to printer.

When powering on the machine, if the optional Memory Expansion boards are installed, the LCD display shows a little crab scuttling across the screen. This crab merely indicates that the printer is undergoing self-tests to ensure working conditions are in order for users.

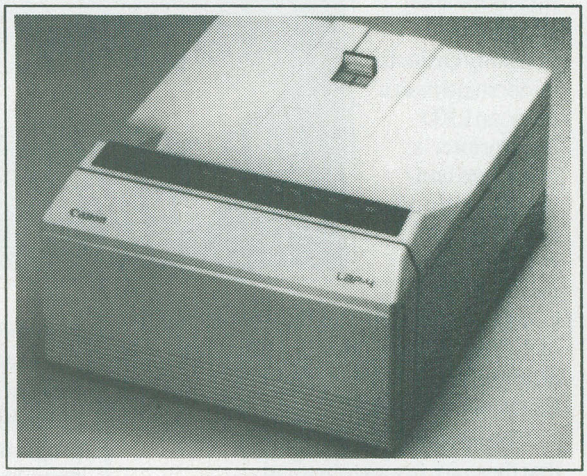
An optional memory expansion board can be installed to increase the memory capacity of the laser printer. The initial RAM capacity is 512K bytes but can be increased up to 2.5 M bytes by adding the optional RAM boards.

On the right side of the printer, two slots are provided for optional font cards. Internally, the printer provides numerous fonts and styles. The font cards extend the versatility of the printer by providing the user with access to more fonts.

As is the case with all laser printers, careful attention must be given to the laser cartridge. The EP-L must be handled carefully and replaced when the cartridge is empty.

The user's manual is extensive. The booklet offers users not only information specific to the printer but also background information in regard to fonts, printing and more. One critical comment stands out when analyzing the booklet. Although a detailed contents page introduces the manual, no index is offered for specific, on-the-spot information. Readers will have to wade through unnecessary material to find what they are looking for.

In summation, the Canon LBP-4 is a worthwhile addition to any office. While the printer speed may be slow for some users, at four pages per minute, many will be pleased at the easy to use printer functions and small footprint.



For more information contact:

Canon Canada Inc.
6390 Dixie Road
Mississauga, ON
L5T 1P7
1-800-848-4123

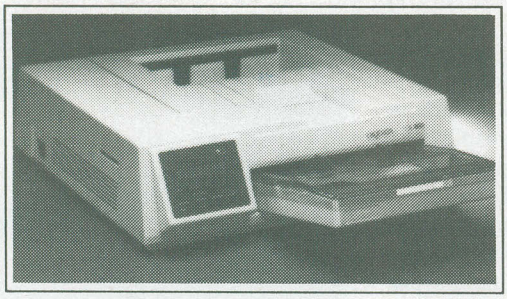
THE OKIDATA OKILASER 400

A laser printer without a laser, the Okilaser 400 is worth considering for low volume printing.

Steve Rimmer

One of the things that makes laser printers moderately expensive is the necessity for lasers. Complex and involving mechanical hardware to scan them, the optical characteristics of lasers are difficult to manage uniformly over the span of a xerographic drum. As with the scanning beam of a television set's cathode ray tube, the laser spot tends to deform at the extremes of its travel and it's difficult to maintain uniform spot density.

Some of the latest generation of laser printers have abandoned lasers for other technologies to get around these sorts of problems. Quite a few fairly exotic ones have turned up, but by far the most common approach to laser-less laser printers is the light emitting diode array approach. Probably easier to understand than a laser, an LED array printer's print head consists of a strip of very tiny light emitting diodes packed at three hundred to the inch, running for the width of the paper. Rather than pulsing a laser on and off, the printer's engine illuminates the diodes.



The advantage to an LED printer is that there are few mechanical parts to get out of alignment, and to manufacture and pay for, for that matter. In addition, the light output of the LED array is constant within the tolerances of the individual LEDs across the whole width of the print area.

This technology has been confined to higher end printers until quite recently; the popular NEC LC800 series PostScript printers, for example. The Okidata OkiLaser 400 is one of the first low end machines to use it.

The OkiLaser 400 is a fairly simple printer. It supports LaserJet series two emulation, which makes it compatible with pretty well any software that will drive a Hewlett-Packard LaserJet. It's also among the slowest of the low end lasers, with its engine capable of only four pages per minute. This seems like a lot at first, but it makes printing long documents pretty time consuming.

One of the things which makes the OkiLaser fairly unusual in the arena of low end lasers is its fairly generous selection of on board fonts. It comes with seventeen selectable fonts, including Courier and equivalents of Times Roman and Helvetica. These are useful if you'll be using the printer primarily to print letters or other simple documents. They obviate the need to buy additional font cartridges if you want proportionally spaced fonts for these applications.

If you do want to buy font cartridges for the OkiLaser 400, you'll have to get them from Okidata. The printer doesn't use standard Hewlett Packard font cartridges, although the data inside them is effectively equivalent.

In fact, most of the software packages that print text to laser printers, desktop publishing applications, drawing programs and so on, do so with downloadable fonts. The OkiLaser 400 will consume standard LaserJet downloadable soft fonts with no complaints, but if you're planning to use a laser with applications which will be downloading fonts, having lots of resident fonts in the machine will be of little advantage to you.

The Okilaser's internals are perhaps a bit more complex than are found in many low end laser printers. You'll have three elements to install and replace, to wit, the photoconductor drum, the toner cartridge and a fuser pad. One positive aspect of this arrangement is that the photoconductor drum is never exposed to light except when it's actually being replaced.

The replaceable supplies for the OkiLaser 400 are at the high end of the range for laser printer supplies. Toner seems to be going for about fifty bucks a pop; one pop will print about twenty-five hundred copies. By comparison, a toner cartridge for my NEC LC890 is thirty-five dollars and is good for about twice as many pages.

The OkiLaser's toner cartridges are fairly elaborate aluminum cylinders. They make changing the toner quick, painless and absolutely clean, but you do have to pay for them.

I was able to find no flaws in the OkiLaser's LaserJet emulation. It survived all sorts of fairly nasty tricks and processed large macros quickly and correctly, a frequent problem for LaserJet emulations. The standard package only comes with 640 kilobytes of memory, expandable to two megabytes. Without its memory expansion, the OkiLaser 400 is all but useless for desktop publishing. Download several large fonts, port over a graphic or two and you'll probably manage to run out of RAM pretty regularly.

The LED engine of the OkiLaser 400 is capable of reasonably good, crisp text. It's not all that happy with large graphics, and tends to produce uneven grey tones. It seems to be more prone to xerographic dot spreading than most, tending to fill areas of very dark grey so they look black.

The major problem with the OkiLaser 400 is not so much the printer itself as its position amongst its competitors. When you consider the basic package plus a memory upgrade, it costs in the same range as a Hewlett Packard LaserJet III, which is both faster and is capable of much better print quality by virtue of its variable size dots. The only really outstanding feature of the OkiLaser 400 is its generous resident font allotment, which may or may not be of much use to you.

For more information contact:

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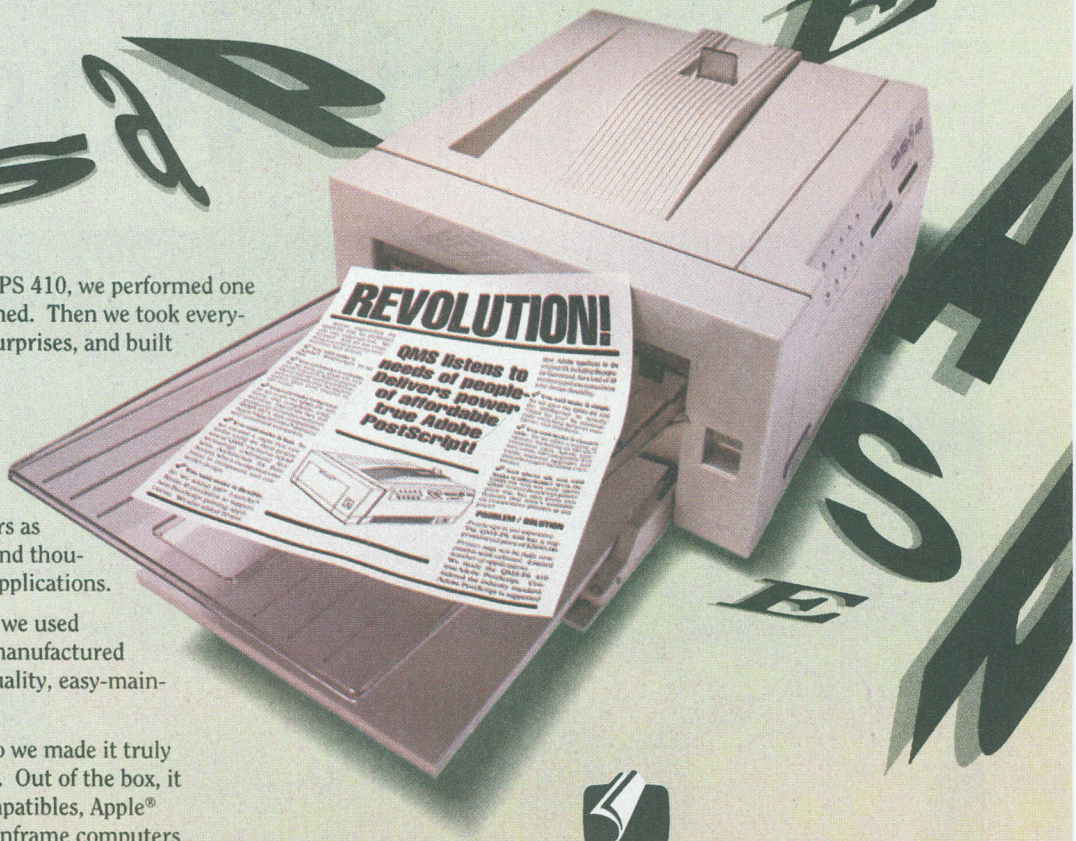

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The EPL-7500 handles paper as well as it handles text and graphics. A 250-sheet tray comes standard, a second is optional. Also standard are serial, parallel and AppleTalk® interfaces, allowing the printer to work smoothly in both PC and Macintosh® environments. For even greater versatility, HP® LaserJet® Series II emulation is included.

Of course, not everyone needs a PostScript printer. That's why the Epson laser line also includes the new EPL-7000. Like the EPL-7500, it offers brilliant MicroArt Printing, superior paper handling and HP compatibility. Plus a host of other serious business features, all loaded into an extremely affordable package. Moreover, the EPL-7000 even allows upgradability to the EPL-7500's true PostScript and RISC processing.

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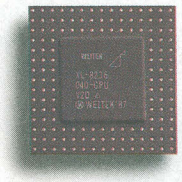

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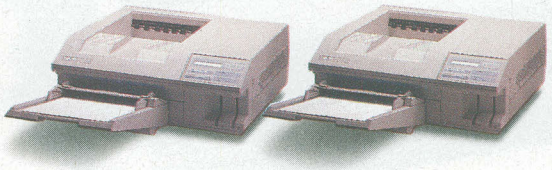

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FUJITSU DL1100 REVIEW

Space is an important factor in any office environment and the DL1100 is a suitable choice for those looking to save on space.

John Swinimer

In today's working office environment, space and the ability to use space to its utmost is crucial for the successful outcome of any productive venture. Fujitsu has designed a printer to meet this space-saving need.

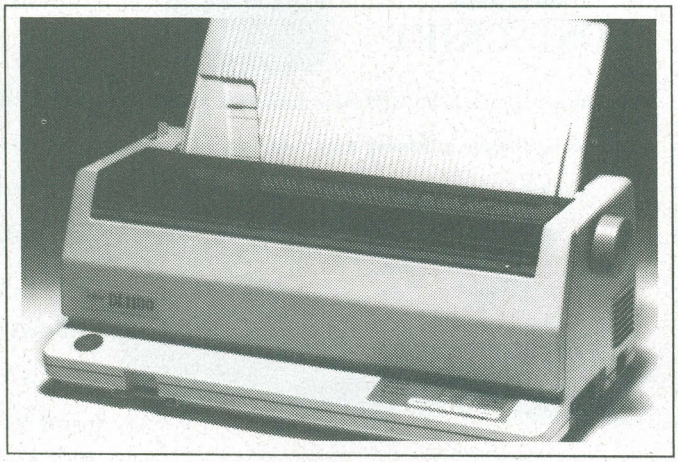
The DL1100 is a 24-wire dot matrix printer with a footprint of approximately 18 inches width x 10 inches depth. One of the unique features of the printer is the design. Due to the small footprint and upright construction, the printer takes very little space on a desk or in a workstation area. Weighing approximately 13 pounds, the printer can be moved from office to office as needed without much difficulty.

Easy to use and operate printer functions are controlled by a membrane-type control panel located at the right lower front of the unit. The control panel offers two modes of operation, normal and setup. Indicator lamps show printer status such as power, on-line, paper out and mode. Combinations of controls provide letter or draft quality, fonts, and menu configuration.

The DL1100 offers software compatibility with the IBM Proprinter XL24 and Epson LQ-2500 and LQ2550 printers. The standard command set is of the Fujitsu DPL24C Plus Printer. Additional printer emulations are available on plug-in cards.

The printer includes eight resident fonts. These fonts include Courier 10, Pica 10, Prestige Elite 12, Boldface PS, Correspondence, Compression, Draft, and High-Speed Draft. For additional fonts, a slot for font cards is located at the lower left front part of the unit. The slot can be used to insert font cards to increase the variety of printing styles. Optional styles include Letter Gothic 12, Scientific 12, Orator, Boldface PS, Light Italic 12, OCR A, OCR B, Dutch 801, Swiss 721, Deluxe Courier, Deluxe Prestige, Script 12, Old English, and Humanist 521.

The DL1100 is comparable in speed to most other dot matrix printers. The printing speed ranges from 50 cps in letter quality to 200 cps in high speed draft quality at 10 cpi. 110 columns for letter size paper are provided of print line in landscape mode. 24K buffer allows 24 pages of text to be stored in the printer.



Users are offered the choice of three types of paper feeding. These include standard friction-feed platen (cut sheets), standard push-feed (continuous forms) or optional cut sheet feeder. A paper guide is included and snaps in place when desired by user. An internal lever can be adusted for paper thickness adding to user-defined printer features.

Some printers can offer users headaches especially when the time comes for printer ribbons to be changed. With the Fujitsu DL1100, this is not the case. By removing the pop-out front cover, the ribbon cartridge can be viewed and changed with ease. The upright design of the printer head allows the cartridge to be easily pulled away from the unit. One of the many options for this unit includes the availability of seven-colour printing by way of optional colour kit.

The DL1100 is relatively quiet for a dot matrix printer. A combination of the top cover and front cover reduces printing noises allowing the unit to be used in most office environments.

A comprehensive user's manual outlines printer functions and more. Programming instructions for the printer are also included in the booklet. Appendices offer information on Command Sets and Interface Information, however, for many users, this sort of information may not be necessary to run the printer. With easy to use features the printer can be plugged in and operated without much ado. However, for those who require the extra printer information for detailed use, the information is available.

Those offices requiring space-saving computer peripherals will be impressed with the Fujitsu DL1100. This dot matrix printer provides accurate printing and many user-defined functions. All in all, the DL1100 is a worthy addition to any office.

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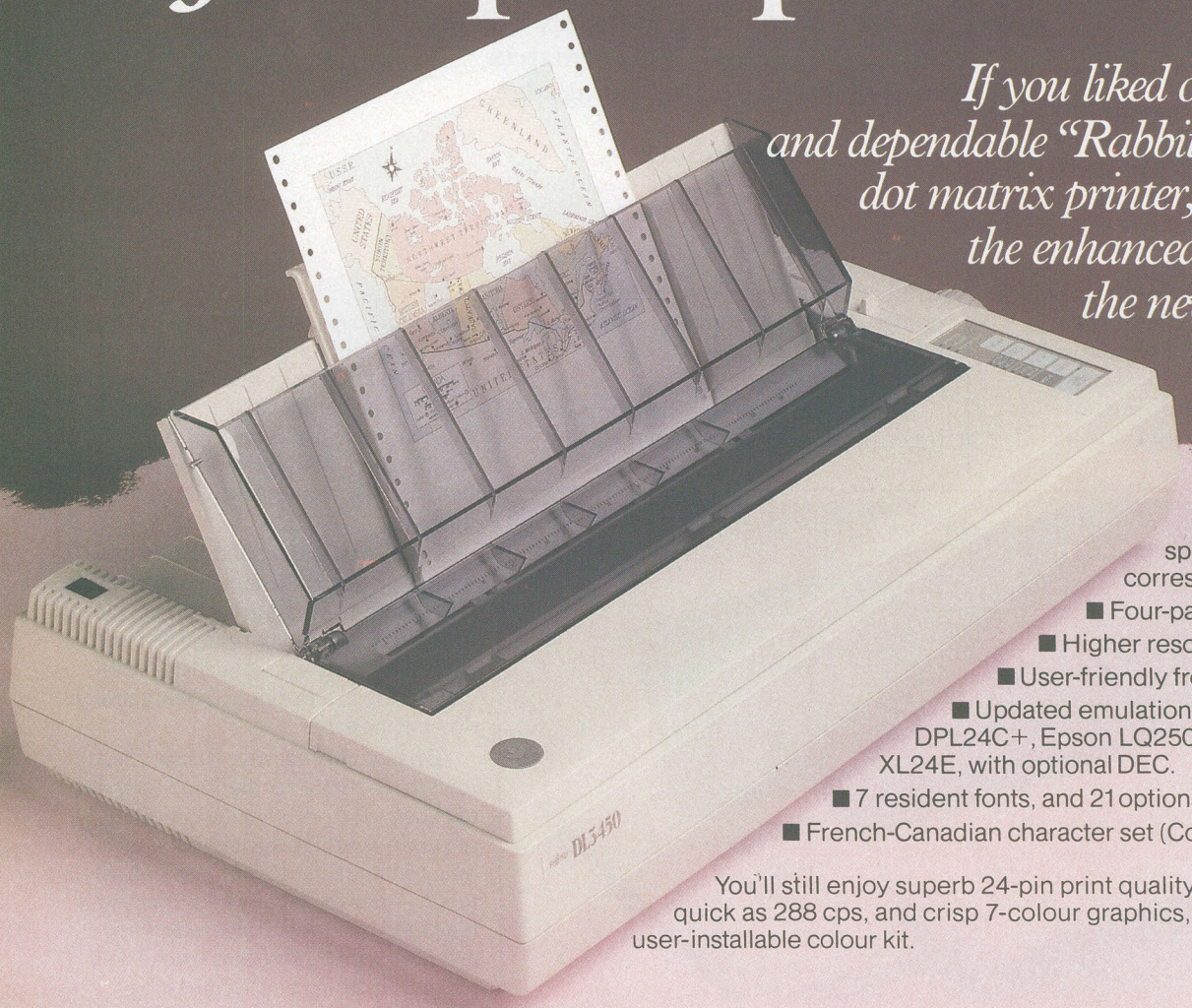

- Four print speeds, including correspondence quality.
- Four-part forms.
- Higher resolution - 360 x 360.
- User-friendly front panel.
- Updated emulations including Fujitsu DPL24C+, Epson LQ2500/2550 and IBM XL24E, with optional DEC.
- 7 resident fonts, and 21 optional fonts.
- French-Canadian character set (Code Page 850, 863).

You'll still enjoy superb 24-pin print quality, at speeds as quick as 288 cps, and crisp 7-colour graphics, with the optional user-installable colour kit.

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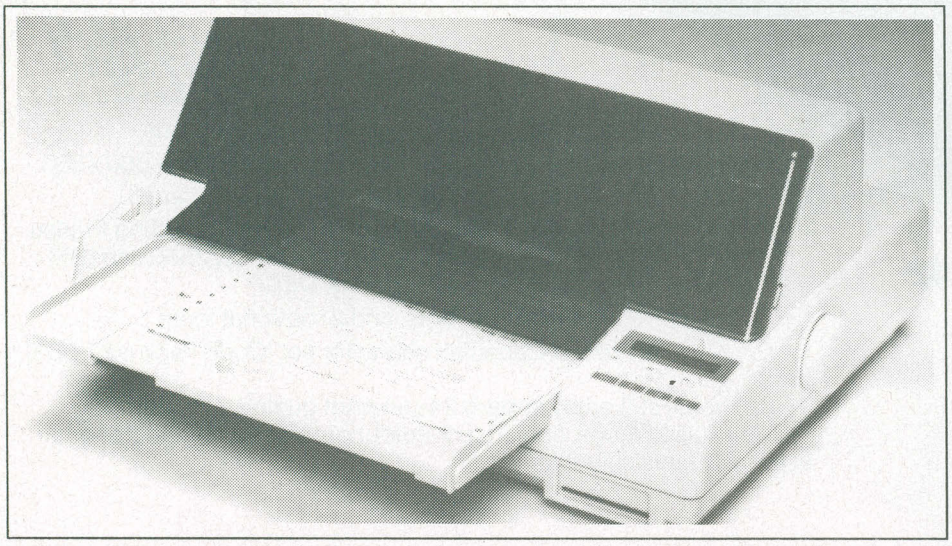
THE C.ITOH C-610 REVIEW

Dot matrix printers, while hardly glamorous, offer a powerful, low cost alternative to lasers. This one is an interesting example of dot matrix technology pushed to the leading edge.

Steve Rimmer

The C. Itoh C-610 doesn't look much like a dot matrix printer. It's a closer match for a stylized plastic iceberg. It also doesn't work a lot like a conventional dot matrix printer. Whoever designed it clearly trashed a lot of the traditional thinking in this area and started over. The result is a printer which will very probably squelch a lot of the complaints people have about dot matrix.



The ideal sort of dotmatrix printer would be one which could print reasonably quickly, reasonably well and without all the convolutions of typical dot matrix printers. The C-610 comes pretty close to this. One of the reasons for this is its paper path.

The route a sheet of paper has to travel to get from the box behind your printer onto the floor in front of it says a lot about how well the printer will perform with awkward sorts of paper; very light single sheets or multiple part carbon forms, for example. Most printers bend the paper around a platen like an old style typewriter. While this makes for a simple printer design, it also restricts the thickness of the paper such a printer will handle at both ends of the range. Extremely thin paper tends not be gripped well enough to keep it from getting off track, and very thick multiple part forms will refuse to follow the shape of the platen, especially at high speeds, resulting in poor print quality.

The C-610 gets around all this by doing away with the curved paper path that usually supports a platen. Paper feeds in a straight line from the back to the front of the printer. The print head lives in a cave on top of the printer, looking straight down at the paper.

This actually has several benefits. It allows the C-610 to handle almost any sort of paper you can find to stuff into it. It results in very high throughput — two hundred characters per second in draft mode — with unusually good quality for high speed printing. It also makes the printer considerably easier to load with paper, something you'll come to appreciate if you're used to coming away from loading your printer covered with a welter of paper cuts and carbon paper smudges.

The printing features of the C-610 are certainly up there with the state of the art in dot matrix printers. It offers draft and letter quality modes. Letter quality mode

uses a thirty-six dot high print character, which produces pretty tight looking type, admittedly at a bit of a speed penalty. Letter quality print at twenty characters per inch drops to 133 characters per second.

The C-610 will emulate the Epson LQ series printers or an IBM Proprinter. It has tractor and friction feeds, and will deal with the outside world through either a serial or a parallel interface. You can select the interface you want, along with a plethora of other options, through a front panel liquid crystal panel and four membrane switches.

The front panel of the C-610 in its setup mode is probably the only really weak area of the printer's design; fortunately, you'll rarely have recourse to it once the system has been set up once. The liquid crystal panel is not backlit and is quite hard to read. The menu structure is convoluted, and you can only get to the setup menu by turning the printer off and on again.

C.Itoh says that the print head is good for two hundred million dots per pin, and the printer itself for five million lines of print. One of the ribbon cartridges it uses will print about four million characters. The C-610 can also be adapted to print colour text with a suitable four colour ribbon and a manufacturers' upgrade.

In operation I found little to complain about when printing to the C-610. Neither of its emulation modes exhibited any irregularities that I could find. The C-610 handled text and graphics well, and very quickly, and never managed to misfeed. It's none too quiet, especially at high speeds and when asked to print graphics, but very few dot matrix printers are bought for their acoustic qualities.

There are still applications for which a dot matrix printer offers the best possible tradeoff of economy and speed. If you need lots of dot matrix output, you'll have a hard time finding a better machine to generate it than the C.Itoh C-610.

For more information contact:
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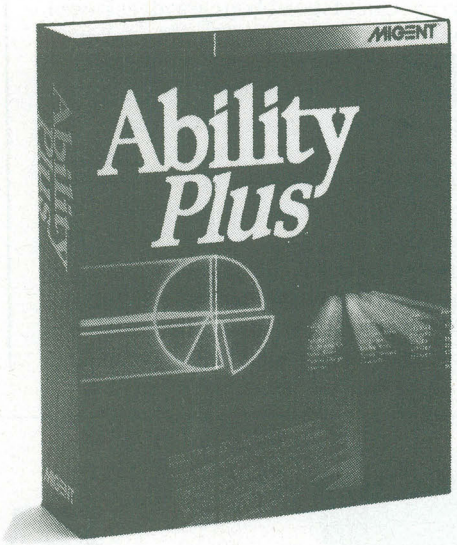

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THE FUTURE OF IMPACT PRINTING

by Doug Polzin

As a once well known wit was heard to quip "The reports of my demise are greatly exaggerated". Recent studies have shown the Canadian printer market is still expanding and is expected to continue to grow by 15% annually to 19931.

New Technologies Are Gaining Market Share

Once a leader, accounting for 25% of the market2, daisywheel printers were being replaced by the higher speed, high quality, 24 pin dot matrix printers who in turn are now feeling the "heat" (excuse the pun) from low end lasers, inkjets and thermal printers.

The survival niche of the "low end" dot matrix printers will be in the areas of low cost personal printers and special application printers.

At the higher end, heavy duty dot matrix and shuttle matrix line printers will maintain market share longer. These products are most prevalent in the large MINI and MAINFRAME systems and network environments where the reliability and functionality of the product are the priority.

Impact Printer Manufacturers Fight Back

To maintain market share, the impact printer vendors will be improving the product and its features while maintaining or lowering the price.

FASTER:

The average speed will continue to increase. Improvements in print head technology increasing the number of pins and their placement have allowed for greater speeds and improved reliability.

BETTER QUALITY:

The print quality has been and will continue to improve. Print head improvements along with more sophisticated controllers have increased the dot density and therefore the quality of the print. Further refinement of these are expected to increase dot matrix performance. Presently resolution on some dot matrix printers can outperform most laser printers.

RELIABILITY:

A proven technology, impact printers, will continue to improve upon their ruggedness and reliability. While the average warranty on a laser printer ranges from 90 days to one year, most manufacturers recommend an onsite service contract, something that adds considerable expense to the operating costs of a laser. On the other hand, leading manufacturers of dot matrix printers are expanding their warranties to as much as two years.

ERGONOMICS:

Control Panels - Today's printers offer easy to access, easy to use control panels, not to mention system level controls. Installations are simple and standardized.

Quietized - Sensitive to the working environment, printer vendors are consistently improving on reducing noise levels.

Paper Handling - Once a forms handling nightmare, impact printers now offer a plethora of paper handling options. Future trends in paper handling capability include for easier paper loading and changing of print jobs, higher multipart copy capabilities, and multiple media online.

PRICE PERFORMANCE INCREASES:

Prices have been dropping in both laser and impact printer groups. It is expected that in the future, vendors will offer more for the money as a way of maintaining market share. Options such as colour may be added at little or no cost. Fonts and other features may be added to enhance the impact printer's capabilities.

Why Buy An Impact Printer?

PRICE PERFORMANCE

Price/performance will continue to be a major factor in the ongoing success of impact printers. On a cost per character, page or feature, the older technology will continue to be price competitive. For the consumers, organizations concerned about controlling MIS/DP costs, impact printers offer much lower operating costs and greater flexibility than the newer non-impact technology.

MULTIPART FORMS

Most organizations, including our government agencies, are hooked on multi-part forms. This application alone will keep the requirement for impact printers strong. Non-impact printers, by their very nature, cannot address this application.

LARGE FORMAT AND ODD SIZE MEDIA

Although there are non-impact printers that can deal with paper formats larger than legal size (8.5" x 14"), the cost is often prohibitive. Impact printers are much more versatile at a much lower cost. This is also true with label, envelopes and oddsize paper and other materials.

CONTINUOUS PAPER

Although this line has recently been crossed, the practicality is still questionable. For a laser printer to have the same versatility with paper handling as the impact printers, the costs are prohibitive.

COLOUR

Although not a large part of the market, colour output demands are growing. Colour output is currently available at the very high end of lasers but for the average user or organization, it is difficult to justify the expense. Many impact printers can offer colour at minimal additional cost if it isn't already a standard feature.

Different Strokes For Different Folks

In conclusion, what each of us should keep in mind is that no printer will satisfy every end-user's needs. IT takes the right printer for right job. The advantages of one printer may in fact be a disadvantage in another application.

The impact printer will continue to be a necessary tool as long as it is the best solution to an end-user's needs.

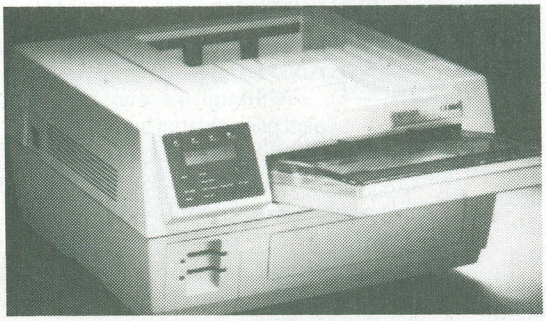
1 Evans Research Corp. Study; Dec. 1989

2 ERC, "Trends in the Canadian Printer Market"; Dec. 1989

Doug Polzin is the Marketing Manager for C.Itoh & Co. (Canada) Ltd., one the largest manufacturers of printers in Canada.

PRODUCT FEATURES

Okidata's 840 crosses IBM/Appleline



The OL840 LED printer ably switches between MS-DOS and PostScript Worlds

Okidata says its 840 laser printer has been designed with the desktop publisher, graphic designer and corporate communicator in mind. The OkiLaser 840 offers among other features, an ability to work in both MS-DOS and Apple environments.

A software-switchable option opens up choice between 35 scalable Adobe PostScript fonts, 26 HP SeriesII and a number of Diablo emulations. The printer can be upgraded to 47 resident fonts by adding fonts through the two font cartridge slots, available through Okidata's library of available fonts.

The printer is driven with the proprietary "Oki engine" based on LED technology, able to turn out eight pages per minute and handle single sheets, mailing labels, envelopes and transparencies.

The company said drop shadowing, gray half tones, pattern fill, unlimited font rotation and downloadable fonts are also featured in the 840. The printer's 2MB of memory can be expanded to 4MB and serial, parallel and AppleTalk interfaces are included.

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QMS ColorScript 100 model 10 packs extra RAM and PANTONE certification

"A new dimension now within reach," is how QMS describes the color capabilities of its aggressively priced ColorScript 100 model 10. Featuring 5MB RAM and supporting legal size printing, Model 10 also carries full PANTONE certification.

QMS describes the Model 10 as *the* plug and play printer, able to hook up Mac or PC with full colour Adobe PostScript. Resident typefaces number 35 and the Model 10 can print hard copy and transparencies in color that adheres to Pantone specifications.

With 5MB RAM, the ColorScript Model 10 supports legal-size printing with a standard region of 8.1" x 12". The printer features a 16MHz/680120 MPU-based internal controller and RS-232 serial, Centronics parallel and RS-422/AppleTalk interfaces plus a SCSI interface for attaching hard disks. The printer ships with an HP-GL emulation for PC environments and Macintosh spooling capabilities

Circle No. 35 on Reader Service Card

Silentwriter Model 90 carries high-end features in compact design

NEC's Silentwriter Series was expanded with the Model 90 PostScript laser printer. The printer uses a laser printing engine with NEC's PostScript controller technology that features Adobe PostScript, LaserJet IIP emulation and 35 scalable fonts.

The 300 x 300 dpi resolution can be printed on letterhead, envelopes, transparencies and labels. Input and output bins each hold 250 sheets.

"Whether you are a Macintosh or PC user, you can set up and use the Model 90 in minutes," the company said. Multiple interfaces (Centronics, AppleTalk, RS-232C, RS422) as well as an NEC software kit with SYSIWYG screen fonts for both Macintosh and Microsoft Windows environments.

Circle No. 36 on Reader Service Card

Kodak introduces Colour Ink-Jet printer

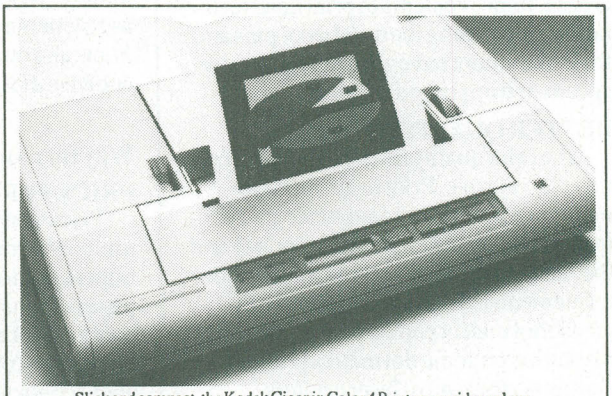
Kodak Canada Inc. unveiled a colour ink-jet printer recently, that produces colour text and graphics, prints on plain paper or ink-jet transparency material, in a compact design.

The Color 4 printer produces colour text and graphics at resolution of up to 192 x 192 dpi and offers print speeds as high as 150 cps in draft mode. The printers footprint is 4" high by 13.7" deep by 20" wide and weighs 13 lbs.

In addition to plain paper capability, the Kodak Diconix Color 4 printer features automatic feeding of up to 60 cut-sheet pages from a built-in paper tray. Continuous-form tractor feed is handled also.

The printer uses four separate printheads, cyan, magenta, yellow, and black inks that produce a full range of colours, printed with Kodak's non-water based inks which will not smear on paper.

The ink supply cartridge can print up to 500 pages of text and graphics.



Slick and compact, the Kodak Ciconix Color 4 Printer provides colour output for both IBM and Apple computers users.

Draft, NLQ and Quality modes are options and paper type, colours and print mode may be selected from the 16-character LCD control panel.

Circle No. 37 on Reader Service Card

Canon's BubbleJet allows for quality portability

"What other printers print on a desk, it prints anywhere," is a **Canon** promotional slogan for the BJ-10e. With minimal size and quality output, the slogan doesn't seem to stray too far from the truth. Canon has struck out at the portable quality printer market with its BubbleJet technology which incorporates a replaceable ink/printhead cartridge. When printing, the ink is quickly heated forming small vapour bubbles in individual nozzles (described by Canon as finer than a human hair). The ink is then ejected onto the paper and dries instantly. Canon says that a cartridge prints approximately 700,000 characters in High Quality mode.

The BJ-10e allows for both portability and quality. Held together in a compact 12 1/4" x 8.5" x 1 7/8", the print head moves at 83 cps in high quality mode and a loudness of 45 dBA.

The BJ-10e can print on letterhead, bond paper, envelopes and transparencies. A 30 page automatic paper feeder can be attached.

Circle No. 38 on Reader Service Card

Fujitsu aims at business, home and school markets with DL1100

Fujitsu has aimed at the business, home and school markets with its DL1100, a 24-wire dot matrix printer carrying a French Canadian character set and an optional colour kit.

The printer has four print speeds, including a high-speed draft output of 240 cps and a letter quality speed of 60 cps. A 24K input buffer allows storage of up to 12 pages of text.

The design of the DL1100 minimizes the footprint size to 7.4" x 18.1" x 9.8" and keeps noise to a minimum 53 dBA.

Optional font cards which plug into the front of the printer include Dutch PS, Swiss PS, Deluxe Courier, Deluxe Prestige and a Special Purpose card (including OCR/A, OCR/B, Scientific 12/18).

Paper sizes range from 102 mm to 330 mm with a full 110 column printing width.

Circle No. 39 on Reader Service Card

Epson LQ-860: 24-pin dot matrix colour printing

Epson Canada Limited introduced the LQ-860, a narrow carriage, 24-pin dot matrix colour business printer which the company said offers high resolution printing, convenient paper handling and higher speed letter quality printing.

The LQ-860 comes with up to 360 x 360 bit image graphics, and four-colour ribbon that can combine colours to create seven colours. The SelecType Control Panel with LED indicators helps access resident and optional fonts, condensed and proportional printing, pitches, short tear-off and paper loading.

The LZR 660 laser printer is packed with PostScript Level 2 interpreter from Adobe Systems

Other features included are SmartPark paper handling system for paper parking, manual short form tear-off, and micro-adjustment; ESC/P code compatibility standard for software compatibility. SuperDraft speed of 300 cps (10 cpi), efficient speeds of 295 cps (12 cpi) in draft and 98 cps in letter quality mode; contains four built-in letter quality fonts and two option slots for added font versatility; and built-in serial and parallel interfaces.

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Commodore's lightweight printer hits Ink Jet market

Commodore Business Machines Limited recently introduced its first offering in the Ink Jet segment with its MPS-1270 Ink Jet printer. The company is targeting small business, home and education markets with the 2.5 Kg printer, packing it with ability to print letters to complex graphics.

Drop on demand thermal ink-jet technology is incorporated into the MPS-1270, as well as the IBM Prop printer or Epson FX 85/80 command set. The printer can reach 160 cps in draft mode and 28 cps in NLQ. With built-in tractor and front loading friction feed the MPS-1270 can handle most types of plain papers up to 8.5" in width.

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Zentronics carrying CrystalPrint Express

Zentronics announced it is carrying CrystalPrint Express, a Qume printer that achieves both compatibility and speed for network printing needs. The printer allows for instantaneous switching o7 3 between PostScript language and HP LaserJet modes without manual intervention.

The CrystalPrint Express runs at 12 ppm, with HP LaserJet Series II emulation or PostScript language. 32-bit RISC microprocessor drives the printer and memory can be expanded up to 8MB. Two 250 sheet trays are incorporated into the CrystalPrint design and resolution can be boosted from 300 x 300 dpi to 600 x 300, depending on the user's needs.

Circle No. 42 on Reader Service Card

Dataproducts' LZR 660 laser incorporates Adobe's PostScript Level 2

Dataproducts Corporation recently unveiled its LZR 660 laser printer, one o the first printers to incorporate PostScript Level 2 software from Adobe.

Dataproducts says the PostScript software and RISC processor from Weitek, ensures the LZR 660 to image complex documents faster and a lower cost than other printers.

PostScript Level 2 is the next generation of Adobe's page description language which defines pages of integrated text and graphics for a variety of output devices. The new release contains a number of performance, functionality and print quality enhancements and is compatible with applications software supporting PostScript language. Level 2 also

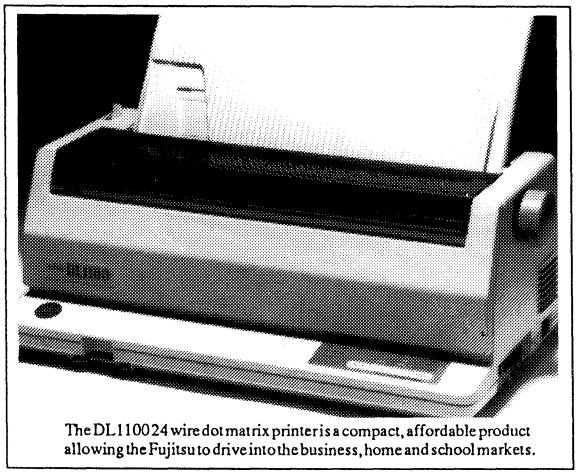
includes forms handling, graphic patterns support, new halftoning algorithms as well as compression and decompression resulting in faster speeds.

The LZR 660 has 6ppm printing with a footprint of 1.3 sq. feet. The printer is available with option, user-installable, automatic envelope feeder that can hold up to 40 business envelopes. A Mac-compatible accessory-selector software is available that allows a user to select accessories through an icon display.

Also included is a duty cycle of 3,000 pagers per month, RS-422/Appletalk, RS-232, and Centronics interfaces, a SCSI port and paper trays which can fit directly below the printer to save space.

Circle No. 43 on Reader Service Card

Panasonic's dot matrix printers approach laser quality



The DL1100 24 wire dot matrix printer is a compact, affordable product allowing the Fujitsu to drive into the business, home and school markets.

Panasonic Communications & Systems Company's Office Automation group recently announced "...a workhorse printer that packs all the features users want." The KX-P1654 printer is a 24-wire, wide-carriage dot matrix printer that features high speed and resolution, with versatile paper handling.

The printer features a super-letter-quality text mode and 360 by 360 dpi resolution for graphics output. A character matrix is achieved of 48 by 30 dots. In draft mode, the KX-P1654 features a burst speed of 375 cps, and 125 cps in letter quality mode. Super-letter-quality output is produced at 50 cps.

An "EZ Set" operator panel is provided to access all printer functions, eliminating the need for DIP switches. Fonts, pitch, text enhancements, form length, lines per inch, micro line feeds, margins, and quiet mode are selectable from the panel.

Seven letter-quality fonts are included which can be combined, sized and enhanced, depending on the user's choice.

As a wide-carriage model, the printer can handle 80-column output for correspondence, and up to 136-column output for spreadsheets and database files. An optional single-bin cut sheet feeder is available.

The 42K buffer is expandable to 74K by using an optional 32K RAM o7 3 card. Centronics parallel and RS-232C serial interfaces are included.

Circle No. 44 on Reader Service Card

Mitsubishi's G650 offers colour thermal transfer printing

Mitsubishi Electronics' G650 is a high resolution colour thermal transfer printer capable of printing on a or B size cut sheet paper or on transparency film.

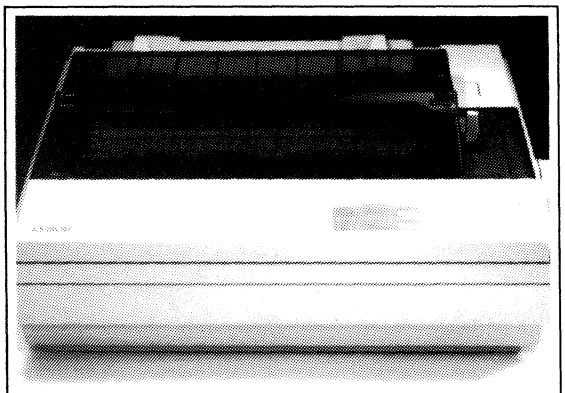
With a resolution of 300 x 300 dpi, the company said the G650 can be used for business graphics, graphics art as well as CAD/CAM applications.

The printer uses "sequential overprinting" and colour mixture techniques to produce high resolution output in seven basic colours – black, yellow, magenta, cyan, green, blue and red. Three-colour or four-colour ink sheet rolls are available in replaceable cassettes. Ribbon life is about 125 (B size, 4-colour) to 210 (A size, 3-colour) pictures per roll.

The printer is designed with an 8-bit parallel (Centronics) interface and can be expanded by adding custom interface circuits to three additional printed circuit board slots in the printer.

The printer offers four display formats – 1x1, 2x2, 3x3, or 2x4 dots – dot density variation.

Circle No. 45 on Reader Service Card



Epson's LQ-860 colour printer comes with up to 360 x 360 bit image graphics.

Mannesmann introduces low cost fast processing laser

Mannesmann Tally Canada has introduced the MT906 laser printer, designed "to change the standard of measurement for true laser throughput."

With 512K of memory and HP Series II emulation, the MT906 uses a proprietary controller, featuring the NS32CG16 processor, and a Mannesmann Tally custom Application Specific Integrated Circuit (ASIC) to boost throughput of mixed text and graphics, and heavy font manipulation.

The company's proprietary "Jade" Controller, featured in the MT906, speeds processing time of complex graphics.

The printer accepts modular language upgrades such as the 2MB or o7 34MB PostScript compatible module and Epson/Proprinter emulations, but also features user-installable 1,2 and 4MB plug-in memory boards.

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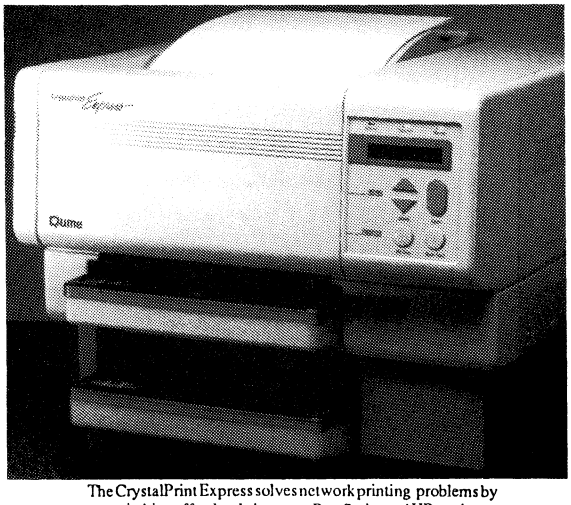

The CrystalPrint Express solves network printing problems by switching effortlessly between PostScript and HP modes.

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The new Genicom 1040 matrix printer adds intelligence to the science of computer printing. That's because the 1040 has the sophistication to deliver what you need quickly and reliably. When you equip your data system with the 24-pin Genicom 1040 printer, it gives you the speed and flexibility your business demands — 432 cps at 12 cpi, 360 cps at 10 cpi, or 90 cps letter quality at 10 cpi.

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The versatile 1040 also offers interface and emulation flexibility with RS232 and Centronics parallel interfaces that are Epson® LQ2500, IBM® Proprinter XL24 and of course Genicom Ansi compatible. To find out more about the Genicom 1040, call your nearest Genicom sales office.

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The OL800: W/200 sheet 2nd paper tray

The OL820: W/200 sheet 2nd paper tray

The OL840: W/200 sheet 2nd paper tray

The OL800: W/multi-user port (3 add'l users)*

The OL820: W/multi-user port (3 add'l users)*

The OL840: AppleTalk Network Ready

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The OL800: No Frills, But All The Options.

For only $1799** list, the Okidata OL800 gives you a full-featured 8 ppm printer: 26 fonts, 4 typefaces, HP Series® II compatibility, both serial and parallel interfaces, and the industry's only 5-year warranty—on Okidata's unique LED printhead.

As your needs grow, you can easily add options that are *no* option with the LaserJet® III—a second paper tray for more flexible paper handling, or a network port that automatically accepts output from three additional PCs in a workgroup. You can even upgrade your OL800 to match either of our high-performance printers described below.

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Besides having more resident scalable fonts than the LaserJet III (13 versus 8), the OL820 also has more brains. Thanks to a unique hardware chip designed by Okidata engineers, it instantly solves complex font scaling, type rotation and gray-scaling problems "on the fly"—problems the LaserJet has to go back to its software to work out.

So the Okidata OL820 can deliver up to three pages of sophisticated text while the LaserJet III is still thinking about printing its first page. In fact, when InfoWorld magazine reviewed the Okidata OL820 they called it "the fastest office printer we've tested."

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Plus you get ingeniously designed MIDI software that opens up amazing new creative and technical possibilities… you actually build your own 4-input audio mixer/amplifier…and you test the electronic circuits at the core of today's new equipment with the hand-held digital multimeter also included in your course.

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Collected Works of John Stuart Mill, a British philosopher credited with shaping the ideology of democratic industrial nations in this century. With its research covering so many areas in the social sciences and humanities, the University of Toronto is a resource rich in expertise — one that is frequently tapped by government and the business world for information and advice.

Discovering Our Heritage

As we move toward a global economy, the beliefs and values of many cultures will be brought into increasingly close interaction. Better understanding of the diverse cultures of the planet is an essential element in promoting peaceful international relations. The University of Toronto is a centre for the study of more that three dozen languages from Chinese, Japanese and Korean, through Russian, German and Italian, to Sanskrit, Greek and Latin. As well, University researchers illuminate the culture, politics and artforms of many regions including the Middle East, Central Europe and the Pacific Rim. History is an essential element of this research. At the Centre for Medieval Studies, one of the foremost institutes of its kind in the world, an interdisciplinary group of researchers delves into all aspects of the Middle Ages. Another group is translating the Royal Inscriptions of Mesopotamia from their original cuneiform into English. The University's scholars are helping to compile the *Dictionary of Canadian Biography* which chronicles the lives of important Canadian men and women from Norse times to the 20th Century. Projects like these reflect the cross-disciplinary nature of modern research. For instance, *The Collected Works of Erasmus* provide valuable insights into the literature, education, politics and philosophy of the Renaissance. Another University group is collecting and analyzing the *Correspondence of Emile Zola*, a 19th-century French author whose realistic portraits of French working-class life have had a lasting impact on Western culture and literature.

The Centre for Computing in the Humanities is assisting scholars in developing new ways of looking at literature. With the help of advanced

1968 *The Collected Works of Erasmus* project begins. Focused on one of the greatest figures of the Renaissance, it is scheduled to be finished in 2011.

1971 Chemist James Guillet invents photodegradable plastics, which begin to decompose when exposed to direct sunlight.
The University erects a 61 cm telescope at one of the most highly prized observing sites in the southern hemisphere, Las Campanas, Chile.

1973 Noted legal scholar and civil libertarian Bora Laskin, a University graduate and Dean of Law, becomes Chief Justice of Canada.

1974 Kenneth Hare, Professor of Geography and Physics, becomes the first Director of the Institute for Environmental Studies.

1975 Researchers in the Faculty of Forestry develop a way to treat trees suffering from Dutch Elm disease and other fungus diseases.

1977 As part of the University's sesquicentennial, the *York Cycle of Mystery Plays* is performed for an international audience. The plays are made possible by a University research team working to unearth records of Early English drama.

1978 The first volume of *The Correspondence of Emile Zola* is published by the University of Toronto Press. By completion in 1995, over 4,000 letters about this French novelist, critic, playwright and champion of social justice will have been published in 11 volumes.

1979 Archaeologist John S. Hollady, Jr. begins a multidisciplinary study of the transit corridor linking Ancient Egypt and Asia. One important result is a stratigraphically dated body of Egyptian pottery for the period c. 609 B.C. - c. 135 A.D.

1982 Computer scientist Steven Cook is awarded the first international TURING award.

1984 The International Astronomical Union names a small planet after University astronomer Dr. Helen Sawyer Hogg.
Geneticist Tak Mak helps identify the T-cell receptor gene, a major advantage in our understanding of the body's immune system.
Archaeologist Donald B. Redford publishes *Akhenaten: The Heretic King*, based on his research at the Akhenaten Temple Project in Egypt.

1985 The first volume of *The Correspondence of Madame de Griffigny* is completed and published by a group of humanities scholars including several from the University of Toronto. A contemporary of Voltaire and Rosseau, Madame de Griffigny wrote during the "Age of Enlightenment" and provided significant insights about this period.
Computer scientist Hector Levesque receives the Computers and Thought Award from the International Joint Conference on Artificial Intelligence.

1986 John C. Polanyi, Professor of Chemistry since 1962, is awarded a Nobel Prize for his work on infrared chemiluminescence.
The University's Centre for Biomaterials, the first in Canada, opens.

1987 A section of the Macdonald-Cartier Freeway (Highway 401) is paved with an experimental asphalt mixed with polyethylene. Early indications are that the material developed by Chemical Engineer Raymond Woodhams, may triple the longevity of highways.
Astronomer Ian Shelton, an observer at the University's Southern Observatory on Las Campanas Mountain in Chile, detects the largest supernova to be observed in nearly four hundred years.
The first volume of *The Historical Atlas of Canada* is published by the University of Toronto Press. This is the first historical atlas to place emphasis on social and economic aspects of a country's history.

1988 Surgeons Alan Hudson and Susan MacKinnon perform the world's first nerve transplant on a 9-year-old boy.

1989 University dental researchers develop a varnish which can eliminate cavity-causing bacteria that normally get trapped in children's braces.
Medical researchers Lap-Chee Tsui, Manuel Buchwald and Jack Riordan announce they have isolated the gene that causes cystic fibrosis. ❐

technology, University scholars are compiling the *Dictionary of Old English*, an endeavour that uses computers to analyze every record of Old English in the world. Meanwhile, at the Institute for the History and Philosophy of Science and Technology, scholars are illuminating the cultural foundations of modern society. Such projects produce new knowledge and understanding of the cultures — both ancient and modern — that make up our world.

From University to Marketplace

As our economy becomes more knowledge-intensive, the transfer of university-developed technology to industry becomes increasingly important. Working from a strong foundation in the basic sciences, the University's scientists are actively developing technologies to serve a wide variety of needs. In the area of advanced materials, university scientists are developing polymers that are stronger than steel. Techniques in recombinant DNA are being perfected in Genetic Engineering projects to help combat cancer, develop heartier strains of vegetation and enhance our forests. At the University's Centre for Biomaterials, the first of its kind in Canada, scientists are working on improved artificial heart valves and on developing better dental implants, connective tissues and replacement joints. The University's computer scientists are utilizing mathematical models to generate life-like computer graphic images which have been used in animation for television and films as well as flight simulators and topographical maps. Another award-winning research group in artificial intelligence is developing computers that can deal with information in ways that allow them to sense, reason and perform useful tasks. Lasers are another key research focus at the University. One research group utilizes lasers to study gases, while another employs ultrashort dye-laser bursts to investigate the motion of molecules in liquids and solids. Optoelectronics, nonlinear optics and lasers in medical applications are also areas of intense research concentration. At the University's Institute for Aerospace Studies researchers are developing fibre optic grids that can detect structural weaknesses in aircraft. Also at the Institute, a collaborative project is researching hypersonic flight to produce an aircraft that can take off from a conventional airport and fly into orbit at 20 times the speed of sound. In dozens of emerging technologies, University researchers are combining their expertise with others from industry and government to ensure that the flow of technology into the marketplace is accelerated.

Tools For Increasing Knowledge

With more than 3,400 active scientists and scholars, the University of Toronto is one of the largest research centres in Canada. It has extensive facilities to carry out research projects that annually attract more than $100 million in external sponsorship. The University's library system which is consistently rated among the top ten in North America, contains more than 7,000,000 volumes. Among others, these include world-class collections of East Asian, Spanish, Portuguese and Medieval materials. In the basic sciences, the University's Observatory at Las Campanas in Chile attracts astronomers from around the world. The SLOWPOKE Reactor, which provides neutron activation analysis, and the isotrace laboratory, a multi-disciplinary centre which offers ultra-high sensitivity analysis of materials such as carbon-14 dating, are shared with researchers in industry and government. At the Ontario Centre for Large Scale Computation, the University's supercomputer supports research projects from dozens of scientists throughout the country. The largest supercomputer in Canada is installed for general use; it can do in minutes, tasks that take conventional computers a full day to perform. In several of the teaching hospitals affiliated with the University, tools such as magnetic resonance imaging units are also used to expand knowledge. At the Institute for Aerospace Studies, researchers have access to a flexible spacecraft emulator which allows them to experiment with the 'real life' situations that large flexible spacecraft might confront. At the same Institute is a subsonic wind tunnel which enables researchers to test the effects of wind on models of airplane configurations and wing designs as well as on ground vehicles and buildings. These sophisticated research tools, along with many others, are helping the university's scientists and scholars to answer questions and to pose new ones. They symbolize the University's commitment to knowledge and exploration.

Putting Knowledge To Use

From its founding, the University of Toronto has been dedicated to the transfer of knowledge. With that aim, its faculty teach students, write books, advise and collaborate with industry and government and are involved in numerous outreach programs, at both the local and international level. The transfer of the knowledge from the University to the community takes many forms and has a significant impact. For instance, the University of Toronto Press publishes more than 1,000 titles, ranging from textbooks and scholarly journals to contemporary works of history and literature.

University researchers also contribute to exhibitions, television and radio programs, as well as to scientific and scholarly meetings throughout the world. Insulin is only the most famous invention made by University of Toronto scientists. They have also helped to develop the cardiac pacemaker, Pablum, photodegradable plastics, a cavity-preventing dental varnish and a better method of processing canola. Through its participation in the Province of Ontario's Centres of Excellence, the University contributes to the development and transfer of technology to industries in five key areas: information technology, lasers, advanced materials, space exploration and automation. The University's scientists also participate in 10 of the 14 federal Networks of Centres of Excellence. Similarly, the University contributes to the development of Canadian Industry through the Natural Sciences and Engineering Research Council's Industrial Research Chairs program, under which it has enhanced research in steelmaking, welding technology, rock engineering, microelectronics design, chemical process metallurgy, nuclear engineering and paper science. Through Ontario's University Research Incentive Fund (URIF), University of Toronto researchers are also engaged in a wide variety of projects which have direct application in industry. These are only a few examples of the types of knowledge transfer which occur at the University of Toronto. They are a good indication of the impact that the University has on Canada and the world. ❐

FEATURE

Occult Electronics

(part 1)

by L. George Lawrence

Throughout history, many an outstanding man has been guided by so-called "occult revelations." Socrates was coached by a disembodied voice, Canadian Prime Minister Mackenzie King was a lifelong visitor to spirit mediums, and even the mentally robust Sigmund Freud discovered that he had psychic propensities.

Today, we witness a revival of occult electronics intended not only to break away from the uncertainties of human mediums, but also to permit structuring of dreams and capture, by instrumental means, *evidence* of starships of Biblical renown.

The evolution of this strange but enchanting panorama traces back to inventor Thomas A. Edison and his attempts to communicate with the dead. As recorded in his *Diary and Sundry Observations*, Edison's formidable genius recognized an immortal dimension that could not be ignored: "Life, like matter, is indestructible. There always has been a certain amount of life on this world and there will always be the same amount. You cannot create life; you cannot destroy life; you cannot multiply life..."

Background

Occultism is a philosophy of hidden forces. It has a natural overlap with religion — the latter dealing, as it does, with supernatural powers believed to be addressable by prayers, deeds, and sacrifice. Occultism has an intense focus on the human soul, and it appears that six stunningly revealing *soul-weighing* experiments, conducted elsewhere, gave Edison exploratory impetus.

In addition, and long concealed by Edison's biographers, Edison's parents were *spiritualists*. A family friend, John Eggleston, reported the following in the occult publication *Banner of Light* (May, 1896): "... I have many times sat in Circles in their home when the great inventor was a child." Such invites the conclusion that Edison had a strong paranormal ability for intercepting new ideas "out of the blue," as his unparalleled record of 1,093 patents suggests.

In 1906, a physician on the staff of the Massachusetts General Hospital, Dr. Duncan MacDougall, conducted a series of critical experiments designed to ascertain the *weight* of the human soul. A full report was published in the *Journal of the American Society for Psychical Research* (May, 1907). The experiments, *never* repeated since, were of stark simplicity yet effective:

A light frame was built on carefully balanced beam scales, sensitive to within 1/10th of an ounce. The frame held a bed on which patients, in dying condition, were placed and observed. The patients' consent was secured weeks before death, although Dr. MacDougall occasionally had to fend off angry relatives protesting the proceedings.

The experiments involved six patients. In each case, there was a distinct, *sudden* drop of weight at the moment of death. The loss was ascertained to be 3/4th of an ounce and assumed to be the weight of the human soul. A number of dogs were put to sleep also, again under carefully balanced and monitored conditions, but no similar losses of weight were noted at the very instant of the animals' demise.

These experiments appear to confirm what occultists and artists have envisioned for centuries — namely, that a wonderful something, a youthful astral body vacates the old mortal shell when the time comes. But if this astral body or "soul" has verifiable weight, it must have mass, and therefore be subject to laws laid down when the Universe was formed some 20 billion or more years ago.

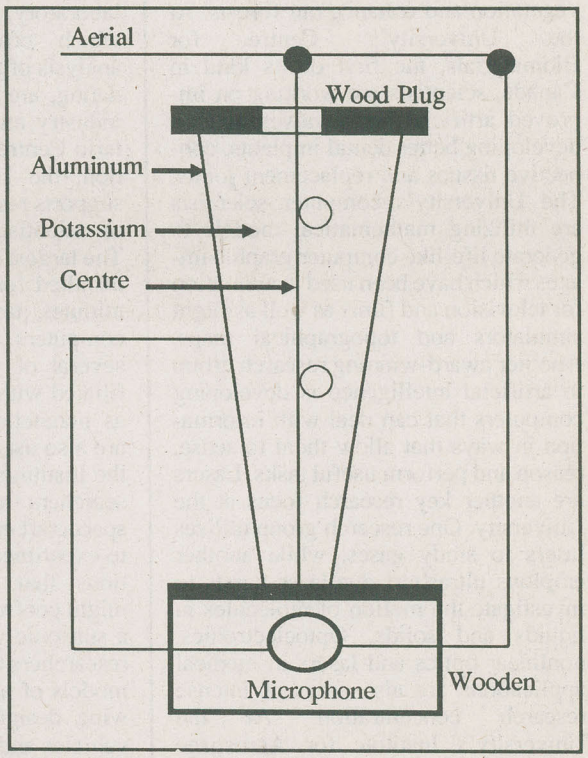
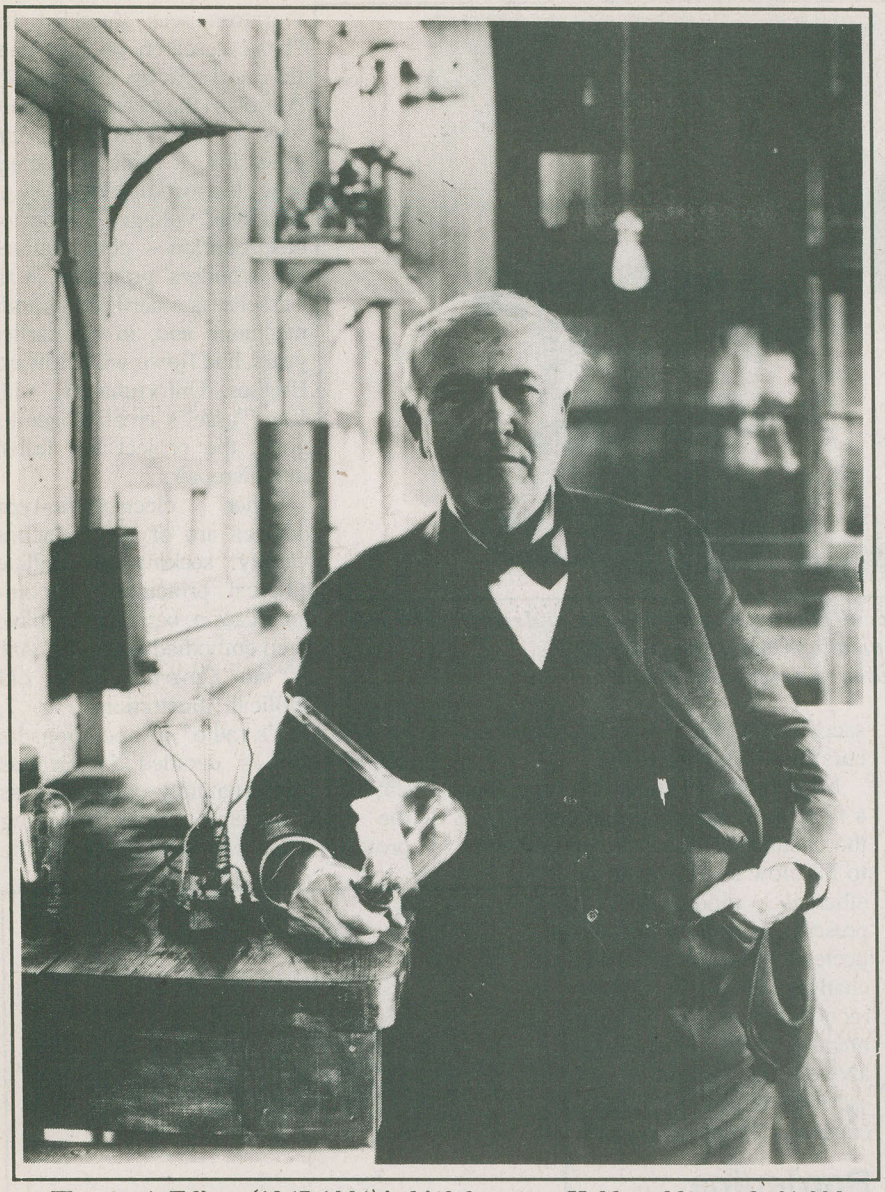


Fig. 1. Purported design of Edison's ELCOWIDE instrument. Based on ethereal modulations of galvanic current and chemical species produced by potassium permanganate. See text.



Thomas A. Edison (1847-1931) in his laboratory. Held world record of 1,093 patents. In 1920, Edison commenced work on apparatus for communication with the dead, triggering eventual rise of occult electronics.

Considering such and other observations, Edison came to the belief that survival after death must in sone degree be physical — perhaps in form or as a submicroscopic "entity" somehow interlocked with an immortal, ubiquitous life force. This entity, Edison reasoned, should be able to put forth physical energy and could activate a sensitive mechanism to announce its presence.

Edison was already 73 years old when, in 1920, he related his intentions to his friend, B.C. Forbes, later founder of Forbes magazine. And so, in October, 1920, *American Magazine* published a story that not only became a world sensation, but also set occult electronics on its course: "Edison Working to Communicate with the Next World!"

Equipment

No complete model of Edison's ELCOWIDE (electrical communication with the dead) apparatus reins extant; drawings are fragmented reconstructions. Nonetheless, the information was sufficient to trigger experimental work around the world.

As per Fig. 1, the ELCOWIDE device appears to have been fashioned in the form of an aluminum trumpet. This container was filled with potassium permanganate surrounding a wire attached to an aerial. Because of the potassium permanganate's oxidizing actions, an electric current was generated and fed, in a series mode, through a microphone. The current and ionic species were supposed to amplify the etheric waves emanated by the "living spirits" against the aerial. The microphone appears to have been a high-impedance *loudspeaker* to permit two-way communication, but was not identified as such.

The ELCOWIDE device did not work in its original form. Subsequently, more advanced and cosmetically more attractive versions arose over a period of years.

The so-called "Omega Phone," an expensive custom-made device, again reflected Edison's ideas, but, was operationally augmented by two items deemed important: (1) a sacrificial urn for burning and holding the ashes of paper money, and (2) a dial-operated Hieronymus mechanism for connecting the apparatus to a domestic telephone line functioning as an aerial. Fig. 2 shows the phone. Fig. 3 is the actual patent drawing from which the Hieronymus mechanism was derived.

Titled "DETECTION OF EMANATIONS FROM MATERIALS AND MEASUREMENT OF THE VOLUMES THEREOF," the Hieronymus machine was *not* an electrical design (it required *no* power supplies!), but an occult instrument generally resembling an LC-tuned resonator circuit. It contained a prism (#28 on the patent drawing), which, when turned to a given position in the presence of an object or phenomenon, was purported to produce a tacky, sticky sensation upon putting fingers to a touch plate (#72 on the patent drawing). See the complete U.S. Patent #2,482,773 for explanations.

Did it work? Yes and no. Some regarded this visually striking apparatus as utter nonsense, while others insisted on having divined much psychological solace and comfort from it, including actual communications, in times of need — typically after the passing of a close relative.

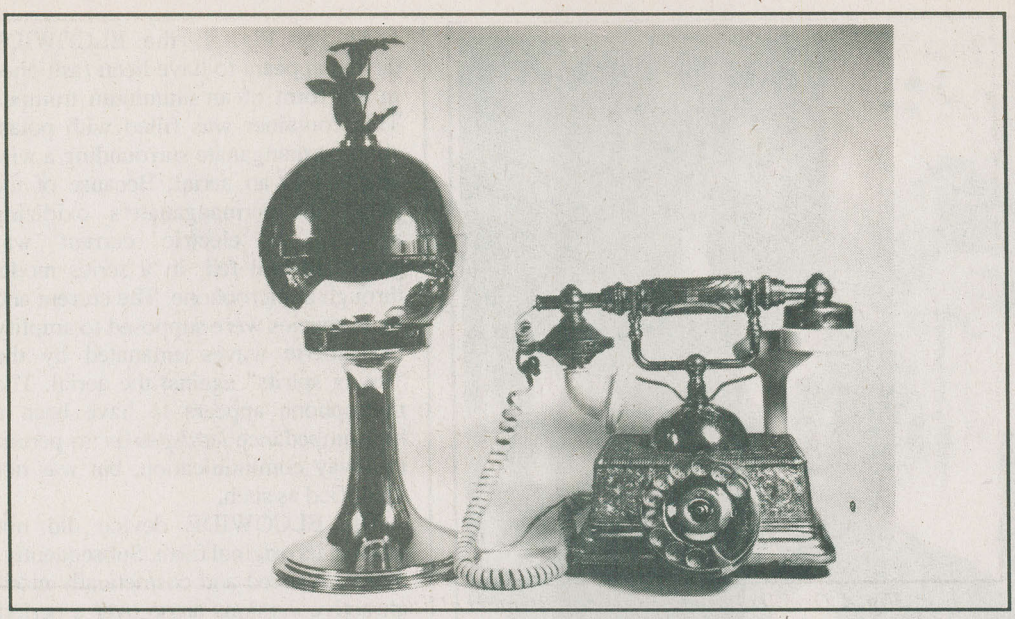


Fig. 2. The **Omega Phone.** ***Employed occult Hieronymus mechanism and sacrificial urn to make ethereal communications intense and memorable. Domestic telephone line served as aerial.***

The afore-mentioned urn was regarded as critical to successful communication attempts. What was demanded here was a substantial *sacrifice* for making ethereal communications *intense* and, thus, *memorable* over a very long period of time. Reducing, say, 1,000 or more dollars in the Omega phone's urn to ashes would, of course, ensure an enduring effect.

Oddly enough, sacrifice-type constellations pervade throughout the traditional religions and most political systems. Depravations are always effected so that the sacrificers may achieve a purpose or goal of greater value than that of the object sacrificed. Some occult electronics reflect this in that *energy* is obtained in an expensive form and dissipated during a communicative or prayer session.

We see this in the battery-powered sepulchre shown in Fig. 4. As per schematic diagram, Fig. 5, the heart of this occult device consists of an automotive, dual-filament lamp normally rated at 12 VDC. One of the two filaments (Fl) functions as an electron emitter (again shades of Edison!), while filament E2 functions as a flexible anode. This is made possible by burning F2 off its mounting fork with high current, typically 117 VAC. Usually, five or more 12-volt lamps must be sacrificed before the desired break occurs and F2 moves freely.

In operation, filament Fl is brought to a faint glow via potentiometer Rl and the ensuing electron stream conveyed to F2 (now an anode). If an ethereal modulator is present, its actions are expected to give rise to voltage changes, which may then be recorded in a conventional manner. As mentioned above. the condition of sacrifice is met by battery expenses: No pain, no gain!

Borderline Systems

Other occult electronics manage to traverse the fine threshold that separates fact from fiction. The late George W. Van Tassel's *Integratron* or time machine, located in the desert community of Landers (near Palm Springs, California), reflects this.

Shown in Fig. 6, the unit was fashioned in the form of a large electrostatic generator to be driven, turbine-style, by compressed air. Surrounded by a protective double-fence, the Integratron was intended for "basic research on rejuvenation, anti-gravity, time travel." Although the overall structure was a masterpiece of engineering, it remains unclear how electrostatic electricity of whatever voltage — short of electrocution — could deliver the wonders promised. Van Tassel was a certified aircraft mechanic and, in his earlier years, had flown with Howard Hughes. Unfortunately, with Van Tassel's creative genius gone, the project has fallen into disrepair.

Other electrostatic-type devices are of the capacitor variety, seeking to emulate ethereal principles of communication believed to have been embodied in Moses' *Ark of the Covenant*. The old Biblical illustration, Fig. 7, shows "God's radio" in operation. Its construction is detailed in Exodus 25:10 ff., unfortunately only as far as the box, metal, and mounting provisions are concerned. The divine

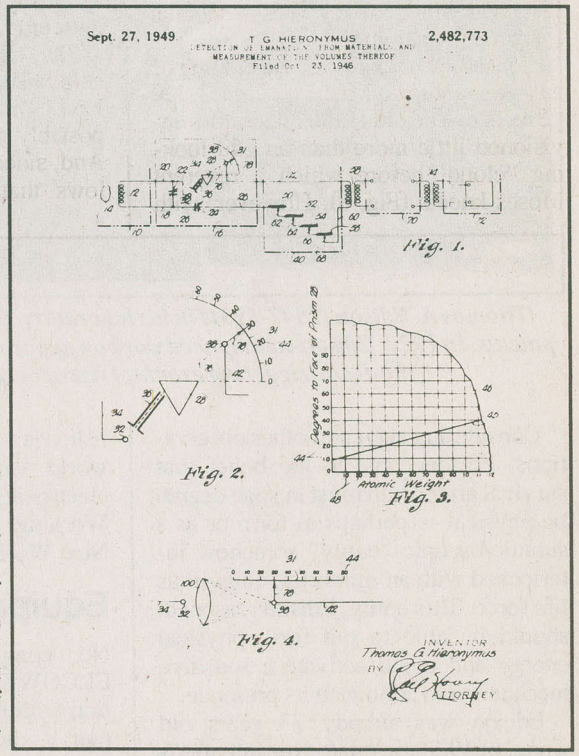


Fig. 3. Title page of U.S. Patent #2,482,773 pertaining to occult Hieronymus machine for 'detection of emanations.' See text.

principle of operation remains unknown, but probably involved far more than a mere application of 2,000 VDC to opposing capacitor plates in order to obtain an electrostatic-type loudspeaker effect.

Curiously enough, it is the so-called *Exodus dimension* which, together with a new interest in the Bible's moral guidelines, continues to supply new ideas to occult electronics. Impetus came from Swiss author Erich von Daeniken's first book pertaining to ancient astronauts (*Chariots of the Gods?*, G.P. Putnam's Sons, N.Y., 1970). Other guidance came from the works of Zecharia Sitchin, most notably *The 12th Planet* (Avon Books, N.Y., 1978), which postulated the *cloning* of modern man in the ancient astronauts' image.

In all of these instances, a vast panorama of ultra-advanced technologies, starships, glorious beings and immortal teachings unfolds before the reader. The "evidence" is of an intensely emotional configuration, with powerful Biblical eyewitness accounts forcing things home.

Consider, for example, the landing of a large starship on Mt. Sinai some 3,500 years ago. The old Bible illustrators envisioned little more than an odd-looking "cloud' before which a reverent Moses kneels (Fig. 8). However, with the verses of Exodus 19:12 ff. poised and ready, a present-day designer of occult electronics interprets this formidable drama in technical terms. The clues are:

"Whosoever toucheth the mount shall be surely put to death; be stoned or shot through — be it beast or man, it shall not live; when the trumpet soundeth long, they shall come up..."

The modern interpretation: A starship with radioactive engines is about land. The Israelis have to stay clear, possibly three or four miles distant. And, since radiation is involved, it follows that biological precautions are necessary. A brief glance at Exodus 19:15 reveals the clue:

"And he (Moses) said unto the people: Be ready against the third day: come not at *your* wives."

Clearly, sexual intercourse was forbidden so as not to produce mutant progeny due to presence of radioactivity. They also washed their clothes — all hypermodern instructions! Of course, the *real* God would not need to sound a noisy siren, shoot trespassing men and animals with modern weapons (lasers?), and decree all those safeguards against radiation poisoning.

The "Magnetwin," shown in Fig. 9, is aligned with these Biblical interpretations. The device contains a small Geiger counter, amplifier with bottom speaker, and a pair of compass devices on top. This borderline item is able to sense nuclear radiation and strong, sudden variations in the Earth's geo-magnetic field — such as a starship of Biblical renown might be able to produce. The novelty is an articulated fiber-optic sensor for detecting motions of a compass needle. Alarms are controlled by knobs. The Magnetwin is said to have a sensitivity of about 50,000 gamma, which equals the average geomagnetic-field intensity or strength in the continental United States. 1 oersted/gauss equals 100,000 gamma; 1 gamma equals 1 nT (nanotesla). A common horseshoe magnet has an intensity of about 1,000 oersted/gauss. An interesting device!

Continued in next issue

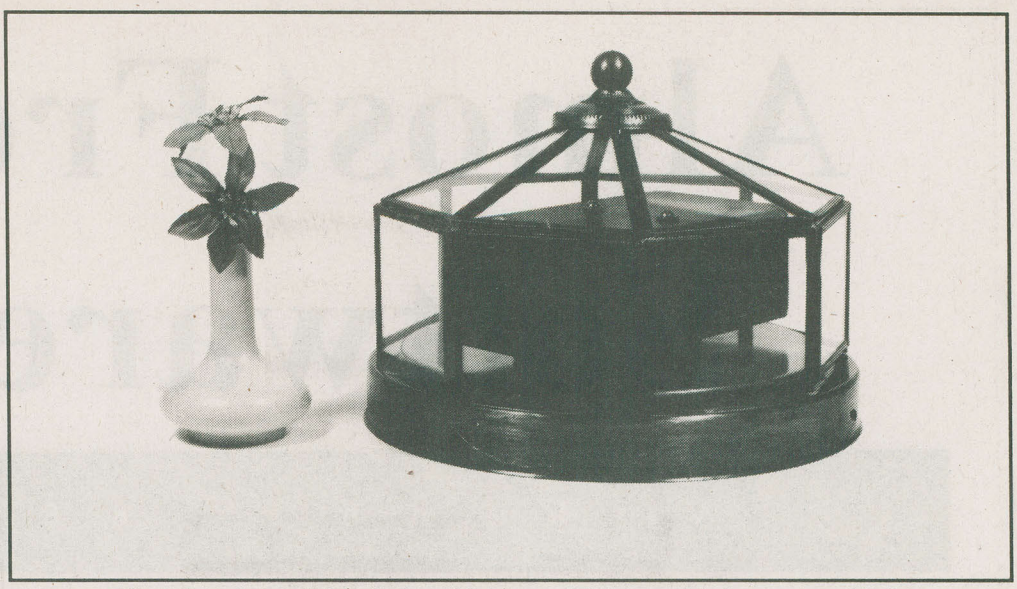


Fig. 4. Occult sepulchre device with internal Edison-effect lamp assembly for battery operation. See schematic, Fig. 5.

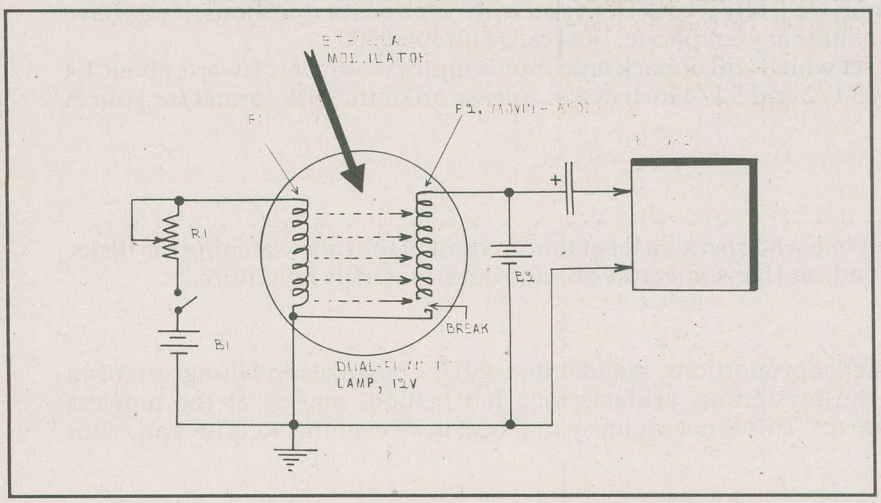


Fig. 5. Operation of sepulchre device was based on ethereal modulation of electron stream emanated by battery-powered filament F1 and conveyed to moving filament F2 acting as anode. Use of expensive batteries satisfied sacrificial requirements.

Almost Free Software

Volume 68

TAX BUSTER

This month's collection of shareware is special. Not only will it entertain you and make your computer more powerful... it will also help keep the government's hands out of your pocket. This collection features *KwikTax*, a spreadsheet which has been custom written to handle the 1990 Canadian T4 income tax form. It will allow you to prepare your own taxes professionally, as well as to find ways to lower your taxes. KwikTax is your personal tactical nuclear weapon in the war against the tax grab. In addition, you'll find a powerful Lotus compatible spreadsheet program in this collection to run KwikTax.

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is a pop up periodic table for Windows 3. It will not only display all the elements, but detailed information about any that you click on.

PRINTER REDIRECT . . . . . .
will capture anything going to your printer and send it to a disk file instead. This is a very sophisticated printer redirection program and has a plethora of options.

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FEATURE

DMM Sound Installations (part2)

by Cliff Asbill, John Fluke Mfg. Co., Inc.

The DMM

Now let's bring these concepts into the real world. The most commonly used device for measuring volts, amps, resistance, power, and electrical db in the field are digital multimeters. DMMs cost anywhere from under $50 to several hundred dollars and more. Even a low-cost unit can do basic measurements but have at least three major drawbacks. First, they are pretty easy to blow up. When you are jammed upside down into the back of an equipment rack, flashlight in your mouth and DMM balanced on your chest, it sometimes happens that the DMM is on a different setting than what you assume. Applying 120VAC to a DMM that is in the continuity mode is one good way to blow up a low cost meter, but there are many other ways, as well.

Second, lower cost meters tend to be less accurate than the better ones. There are a lot of adjustments in audio that must be made with a highly accurate meter. For example, in replacing level-controlling componentry in an automated VCA mixer the slightest miscalibration can result in serious mismatching and performance problems.

Finally, and for the purpose of this article most importantly, a low-cost DMM usually lacks the features necessary to carry out many of the more critical operations we will be discussing. Probably everyone reading this article owns a DMM, but many field installers use it only for basic continuity and voltage tests so they don't think they need a sophisticated meter. As we will see, you cannot set up a sound system properly without certain sophisticated features like hold and relative db. If your meter doesn't have these features, you need one that does. In this article we will use the Fluke 45 as our reference DMM, and all the operations described can be accomplished with this meter. The Fluke 45 is an excellent choice for professional audio applications because it's affordable ($595) and has all the features that an installer and technician needs. Moreover, it is highly accurate, very rugged and well-protected against operator error and unexpected inputs, and incorporates features that no other meter in this price range has. @SUB-HEAD = **Measuring Voltage And Power**

There are many voltage measurements that should be made by the installer. The first voltage to be measured is the AC coming out of the wall. Sudden surges of voltage can cause damage to electronic equipment, and consistent overvoltages will, at the very least, reduce long-term reliability. Under voltages will result in reduced audio performance. So before you plug sound equipment into the house AC, it is important to check for voltage irregularities.

With a Fluke 45 you have the option of making these tests in several different ways. But regardless of the test procedure used, you should leave the DMM hooked up to an outlet for at least twenty-four hours, preferably on a weekday when industrial and commercial electrical use is usually heaviest. Using the "min/max" feature you can come back at the end of the test period and ask the DMM to read out the lowest and highest voltage monitored. Imagine how thankful you'll be for running the test when you find that the min/max range swung from 112 to 135VAC! You can also leave the DMM in the hold mode in which case you would have found 135VAC on the screen when you returned. Or you can preset a threshold that represents the upper limit of acceptable voltage, say 125 VAC; in this case the word "fail" would have appeared on the second readout.

However you choose to run the test, RUN THE TEST! If you have spikes and brown-out problems in a building, you can be guaranteed that the sound system equipment will not enjoy normal reliability.

Many installers don't realize that power supplies are often out of adjustment, even with new equipment. A power supply putting out too high a voltage can significantly reduce the reliability of ICs. Conversely, too low a voltage can result in diminished performance, particularly in terms of headroom and signal-to-noise. So a diligent installer should check all external and easily accessible internal supplies for voltage accuracy and ripple. The dual readout feature of the Fluke 45 makes this operation easy because it can read and display DC voltage and AC ripple, or voltage and frequency, simultaneously.

Another measurement that can save you a lot of headaches, but can only be made with a sophisticated meter, has to do with identifying ground loops and stray voltages. To eliminate ground loops and the concomitant buzzes a sound system must have only one path to ground. This is easier said than done. Electrons never miss a trick: if there is an alternate circuit open to them they will find it. They will go through your

See **DMM**, *page 36*

Babani Book of the Month

Welcome to our new feature, the Babani Book of the Month. In each issue we will present an excerpt from a particular Babani Book. This month we are featuring *Modern Op-Amp Projects* by R. A. Penfold, book number BP106. To order this, or any Babani book, fill out the order form at the end of this article and send it in with the appropriate payment.

Battery Monitor

This simple device can be used to monitor a 12 volt car or boat battery and give warning if the battery voltage starts to fall to an unacceptable level. The unit has four LED indicators, and these switch on if the supply voltage falls below a certain threshold level, with a different threshold voltage being used for each LED. The approximate threshold potentials are 10, 11, 12 and 13 volts, but these can easily be changed, as explained later.

The circuit utilizes a quad comparator, and strictly speaking, this device is not a quad operational amplifier. The difference between a comparator and an operational amplifier is very small, and they are largely interchangeable. The device used in this circuit is the MC3302P, and this has four identical comparators which have common positive and negative supply pins. Like an operational amplifier, there are two inputs (inverting and non-inverting) plus an output for each section of the device.

The comparators only really differ from an operational amplifier in that the output terminal connects to the open collector of a common emitter (NPN) output transistor. In normal use the output transistor is used to supply current to a load of some kind if the inverting input is at a higher voltage than the non-inverting one, and cut off power to the load if the comparative input states are reversed. Of course, the fact that an operational amplifier does not have an open collector output does not preclude its use as a voltage comparator, and if a comparator is given a discrete output load of some kind (a resistor of a few kilohms in value is sufficient) it functions as an operational amplifier.

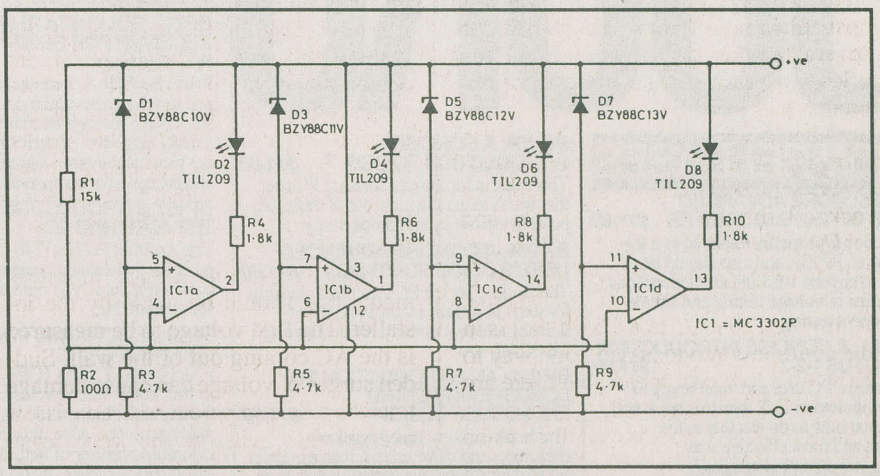

Fig. 1 The Circuit Diagram of the Battery Monitor

The Circuit

Figure 1 shows the full circuit diagram of the Battery Monitor, and this consists of four virtually identical stages. The only difference between the stages is the voltage of the zener diode used in each, and this voltage is chosen to give the desired threshold voltage.

If we consider the stage which utilizes IC1a, the load for the output transistor of IC1a is LED indicator D2 and its series current limiting resistor R4. There is no form of output current limiting built into the output stage of each comparator, and discrete components are needed to ensure that the maximum permissible output current of 20mA is not exceeded. The inverting input of IC1a is fed from the supply lines via the potential divider formed by R1 and R2. Obviously, the voltage fed to the invert-

Continued

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This book is aimed at beginners and those of limited experience of electronics. Using the simple component and circuit testing techniques in this book the reader should be able to confidently tackle servicing of most electronic projects.

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R.A. Penfold
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R.A. Penfold
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An unusual and fascinating chart that is highly recommended to all those interested in electronics and which will hopefully pay for itself many times over, by enabling the rEader to use IC's that might otherwise have been scrapped.

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E.A. Parr

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F.A. Wilson, C.G.I.A., C.Eng.,

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F.G. Rayer, T. Eng. (CEI), Assoc.IERE.

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Although information on stand circuits blocks is available, there is less information on combining these circuit parts together. This title does just that. Practical examples are used and each is analysed to show what each does and how to apply this to other designs.

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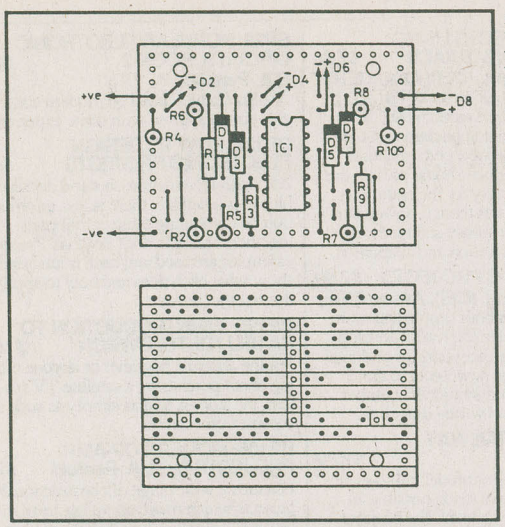

Fig. 2 Constructional Details of the Battery

ing input will vary with changes in the supply voltage, but it will always be quite small, and is unlikely to become more than 100mV (0.1 volts). This bias voltage is fed to the inverting input of each comparator. IC1a's non-inverting input is fed from the supply lines by way of zener diode D1 and D1's load resistor is R3. Under normal operating conditions the supply voltage should be a couple of volts or more above the avalanche voltage of D1, and about two volts or so will be present at the non-inverting input. The output transistor of IC1a is therefore switched off and D2 is not switched on.

If the supply voltage falls below about 10 volts, D1 ceases to conduct and the voltage fed to the non-inverting input falls below the small bias potential at the inverting input. The output transistor of IC1a then switches on and D2 lights up. The other sections of the circuit operate in exactly the same manner, but the zener diode is in each case chosen to give a different threshold voltage. The threshold voltages can obviously be altered if desired, and it is simply necessary to choose a zener diode having a voltage equal to the desired threshold voltage. The circuit will work using zeners having operating potentials of just a few volts, although it would be advisable to reduce R4, R6, R8 and R10 to 1k if the unit is to be used with low supply voltages in order to give a reasonable LED current and brightness. The supply voltage must not exceed 28 volts which is the maximum permissible supply voltage for the MC3302P device.

Construction

A 0.1 in matrix stripboard having 19 holes by 14 copper strips is used as the constructional basis of the Battery Monitor, as can be seen by referring to the constructional diagram shown in Figure 2. The MC3302P is not a MOS device and requires no special handling precautions. In fact electrical construction of the unit is perfectly straight forward and should not give the constructor any real problems.

Mechanical construction must obviously be varied to suit the circumstances under which the unit will be used. This is really just a matter of using a little initiative, and is again something that should not give any real difficulties. The current consumption of the unit with all the LEDs switched off is only about 1.5 to 2mA, but this obviously rises considerably when one or more of the LEDs are switched on. In fact, the increase is about 6mA per LED.

Parts List

Resistors, all 1/2 watt, 5%

R1 – 15k, R2 – 100 ohms

R3, R5, R7, R9 – 4.7k

R4, R6, R8, R10 1.8k

Semiconductors

IC1 – MC3302P (or Sylvania ECG 834) Quad comparitor

D1 – BZY88C10V (or Sylvania ECG 5019A)

D3 – BZY88C11V (or Sylvania ECG 5020A)

D5 – BZY88C12V (or Sylvania ECG 5021A)

D7 – BZY88C13V (or Sylvania ECG 5022A)

D2, D4, D6, D8 – TIL209 (or Sylvania ECG 3007) general purpose red LED

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DMM, *Cont'd from page 30*

rack rail from mixer to equalizer to amp, they will use the shield of the interconnect cables, they will use the conduit in the building. But if we remember our basic electronics, we know that any length of cable will have some resistance, albeit very small in some cases. And if current is flowing through the cable, a voltage drop will occur. Thus we can detect and quantify the various legs of the ground loops. Alternately, we can measure the current directly by interrupting the circuit.

In any case, the ultimate goal is to eliminate all paths to ground except for one high quality ground. This can be a difficult task, particularly when unbalanced equipment is in use and when equipment is located in different locations. But a DMM sensitive and accurate enough to measure, and differentiate between, the small voltages and currents typical of multiple ground paths can help you identify and solve these problems.

One of the handy features of certain sophisticated DMMs is the ability to compute audio power. According to Ohm's law, if we know the voltage, current, and resistance — or any two of the three — we can compute power. Some meters can do this calculation for you. Thus you can "measure" audio power without worrying about miscalculating: just enter the appropriate value of resistance and the meter will do the rest. This, and other, test operations are made faster, easier, and more foolproof by the dual read-out feature of the Fluke 45.

Measuring DB

One of the biggest oversights in setting up a sound system is failing to make unity gain adjustments. Many installers simply hook up the mixer, processing, crossovers, and amps, and then crank them up until the system is loud enough. A system set up by this seat of the pants method is likely to result in unacceptable level variations at interconnect points. For example, the mixer and equalizer might be getting +16dbu, while the signal between the equalizer and crossover

might be getting -15dbu. It is true that modern audio equipment can accommodate a wide range of signals but it is very important to have each device operating at its optimal level. If you have some devices running near overload and other devices running with the signal way down in the noise floor, you are asking for problems: the result can be distortion, unsatisfactory headroom, unacceptable hiss and buzz, radio pickup, reduced reliability of components, lack of operational flexibility, or in general terms, greatly diminished sonic performance.

So it is critical that the installer check and adjust signal levels in between each piece of gear until there is unity gain throughout the system. This will not be possible, of course, if there is mismatched equipment: a +4 equalizer hooked up to -10 compressor, for example, or a balanced output (of a type that cannot be unbalanced without a several db loss of level) hooked up to an unbalanced input. But assuming that all the equipment is +4 and has well designed inputs and outputs, the signal level carried by the interconnect cables should remain constant throughout the system.

The easy way to make these measurements and adjustments is to use a sine wave generator as source. Plug a 1 khz tone into the mixer, set the input channel to an optimum gain structure (as indicated in the mixer's user manual), attach your DMM leads to the output of the mixer, and raise the mixer's master output until your DMM (set on VAC, 3V scale) reads 1 volt (this is for dbv, set to .775 volt if you prefer to work with dbu). Then hit the "db ref" button on the DMM. Now your meter is calibrated to 1 volt = 0 dbv (or .775 volt = 0 dbu if you chose that reference). You may now adjust the mixer's level up or down and the DMM will read the change in + or - db. The meter will not read out dbv or dbu — it reads db only — so it is up to you to make sure you know what the zero reference is. Be careful to look closely at equipment specifications so that you don't confuse, say, dbm with dbv or dbu since these scales all have different 0 db references.

If the specifications on a mixer say that +4 dbu = 0 vu on the mixer's meter, then you might use +4 dbu as a handy reference level. So use .775 volt for the DMM set-up and raise the mixer level until the DMM reads +4 db. Now move your DMM leads to the output of the next component (probably a compressor or equalizer). Adjust the master gain of this device until you read +4 db. Repeat this process until you reach the output of the electronic crossover (if the system is active). Be careful here, because you will obviously have to sweep the oscillator frequency up or down so as to steer around the attenuation slopes. This can be best accomplished by using test tones mid-way between crossover points. At the outputs of the crossover, it may be necessary to adjust the level up or down from +4 db because, unlike most processing equipment, amplifiers do not necessarily subscribe to a nominal +4 level. Different amplifiers have different input sensitivities, and often those sensitivities will be specified in volts rather than db: some require 1V for full output power, others require 1.5V, still others require .7V, and so on. Refer to the amplifier's user manual to find how input voltages or decibel values correlate to output wattages, and adjust the signal levels accordingly. Of course, you can also adjust the input attenuators on the amp, but unless you have unusually sensitive amp inputs, you will usually find that it is better for the sake of system headroom to leave the attenuators wide open.

Once you have completed this system-wide set-up procedure, you can be sure that each component in the system is operating at an optimum level, and thus is providing optimum performance. We have now created the ideal starting point for the system. But realistically we cannot expect to maintain perfect unity gain throughout the system because once we make equalizer and compressor adjustments we are bound to change the levels a little. If you are doing extreme amounts of EQ and compression, then you should go back and readjust for unity gain; but if you are making only minor processing adjustments, then readjustment is unnecessary.

Checking The Phase

One final test that some installers make is a system phase check. More precisely this amounts to a polarity check, for if it turns out that the system output is not in phase with the system input, the installer is not able to dial in the phase a degree at a time like you can in setting up a tape recorder. Usually if a phase problem is detected it is a matter of being 180 degrees out of phase. This probably means either a cable or component is out of phase, so correction is easy. One easy method of checking phase with a DMM is to run a +4 dbu

see DMM, page 36

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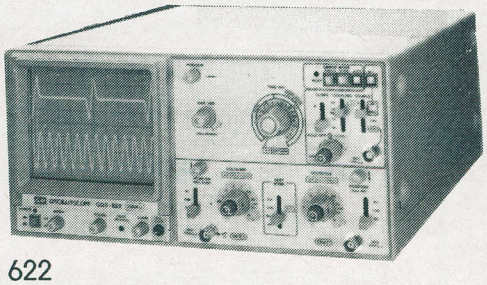

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DMM, *Cont'd from page 35*

100 hz sine wave through the system while simultaneously sending that tone to the input of the amp, thus bypassing all the other equipment in the system. At the amp input (make sure the amps are turned off), use a resistive bridge to combine the original tone with the tone that is running through the system. If the system is in phase, the addition of the original signal to the amp input will increase the system signal by 6db on the DMM (this assumes you are using a db scale referenced to voltage and that each of the two signals being combined are of equal amplitude). Even if your signals are not equal, the effect will still be additive. But if the system is out of phase, the system signal at the amp input will decrease by at least several db due to phase cancellation.

If you wish to make a more comprehensive phase check of the system, one that uses the amplifier outputs, you should use a dual trace oscilloscope. If you are going to take a scope into the field with you anyway, you can also make system gain adjustments with it. Although a DMM can do this job just as well, a scope can compare signal levels simultaneously without repatching. Also if you prefer to use a program other than a sine wave (pink noise or music program) for system checks you will find a scope more suitable than a DMM. An oscilloscope suitable for sound system installations and maintenance should be portable, rugged, and reasonably priced. A Fluke PM3055 would be an excellent choice.

We have all seen how inattention to proper techniques can result in disastrous and costly system failures. In this article we have discussed how a sound system installer can greatly improve system reliability using a high quality DMM. The techniques described take only a few minutes, and can save a lot of frustration, time, and money in the long run. ❐

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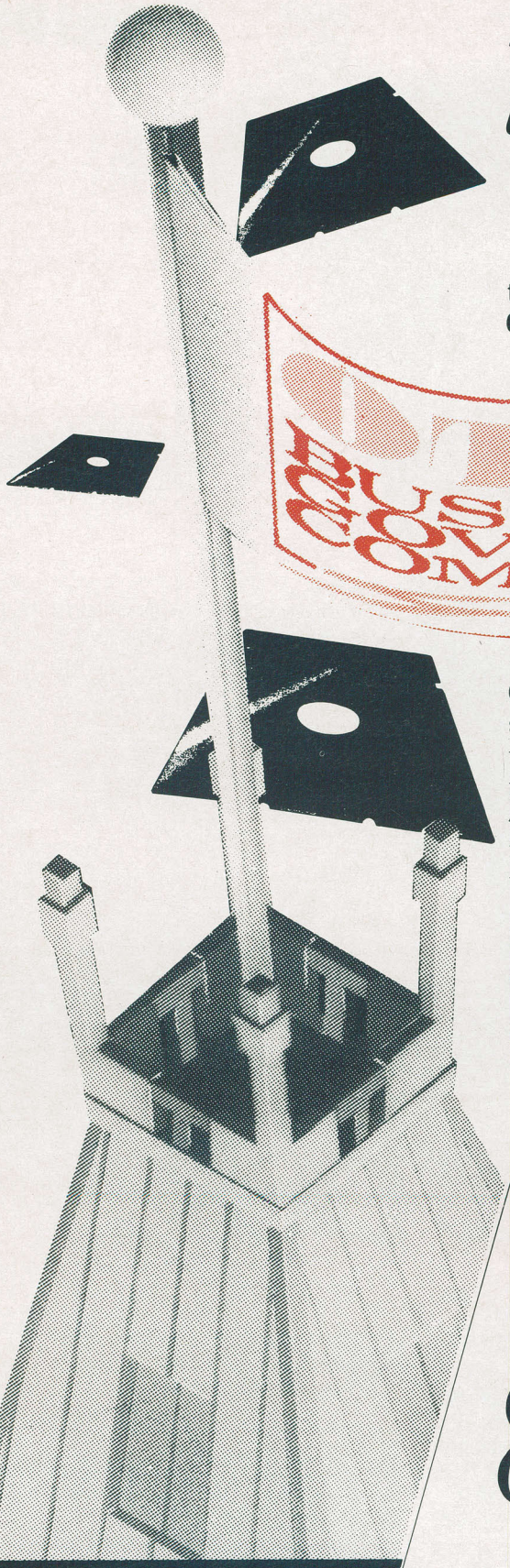

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